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No, 33

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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

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No. 33

This serial publication contains abstracts of articles and news items from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

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LIE ALGEBRAS OF HOMOTOPIC GROUPS OF MINIMUM SULLIVAN MODELS

BABENKO, I. K., Moscow State University imeni M. V. Lomonosov

[Russian abstract provided by the source]

[Text] The paper examines a minimum model in the Sullivan sense of a singly
connected triangulable space. Homotopic groups of the model are considered,
and it is shown that they form a graded Lie algebra. A theorem is proved on
the isomorphism of this algebra and the tensor product of a classical Lie
algebra of homotopic space groups by the field of rational numbers. Refer-
ences 3: 1 Russian, 2 Western.

EXISTENCE AND UNIQUENESS OF THE SOLUTION OF THE POISSON EQUATION FOR GENERALIZED
MEASURES ON AN INFINITE-DIMENSIONAL SPACE

BENTKUS, V. YU., Moscow State University imeni M. V. Lomonosov

[Russian abstract provided by the source]

[Text] It is proved that the solution of the Poisson equation in the space
of generalized measures of an infinite-dimensional separable Hilbert space
exists and is unique. Every generalized function concentrated at a point in
the infinite-dimensional Hilbert space is equal to zero. References 7 Russian.

CORRELATION PROPERTIES OF AN ACOUSTIC WAVE WHEN MULTIPLY REFLECTED FROM A
ROUGH SURFACE

GULIN, E. P., Acoustics Institute, Academy of Sciences USSR, Sukhumi Branch

[Abstract] Reducing multiple reflections to single, multiply repeated re-
flections is the simplest way of approximately calculating the correlation
characteristics of a wave field when there are multiple reflections from a
statistically irregular surface. Examined is the case of high irregularities,
for which the familiar Kirchhoff approximation is used (in the absence of
shadowing). The correlation moment describing the frequency-space-time
correlation of the wave field was calculated for the case of multiple re-
flections from an irregular boundary in a layer lying on a uniform half-
space. The results show both exponential and power-law drops in frequency
correlation. The scales of correlation with increase in the number of re-
flections from the irregular surface were observed to decrease for longi-
tudinal as well as transverse correlations. Applicability of the results
is limited due to transition from normal waves in a waveguide to rays with
specific grazing angles; limitations also arise due to use of the Kirchhoff
approximation and the approximate calculation of the integral by the
stationary-phase method. In addition to other limitations, the results
are inapplicable in describing correlation characteristics of a scattered
field when there is a large number of reflections n, in which the angular
"blurring" becomes comparable with the grazing angle specularly reflected
from the middle plane. References 7: 6 Russian, 1 Western.

DISK-TYPE CONCENTRATORS OF RADIAL VIBRATIONS

VASIL'YEV, P. YE., and KAZANTSEV, V. F., Acoustics Institute, Academy of
Sciences USSR

[Abstract] Oscillatory systems relying on radio vibrations of disks or rings
may be constructed with resonance concentrators strengthening the vibration
amplitude. A stepped concentrator, a flat disk variable in thickness with
an opening in its center, is the simplest type of disk concentrator of radial
vibrations. From an examination of the equation of radial vibrations of a

disk with a central opening of constant and of variable thickness, working formulas were derived to find the resonance dimensions and gain of a stepped concentrator of radial vibrations, and a concentrator whose thickness depends linearly on radius. The calculations were experimentally checked on a number of concentrators of different shapes and dimensions. Excitation was by the Poisson effect through piezoelectric transducers. The transducers were pointed on the end supporting the concentrators to minimize the contact area and eliminate any influence of the transducers on the resonance parameters of the concentrators. The amplitude of radial vibrations was determined by a bimorph vibrometer. A microscope was used to measure the distribution of the amplitude of radial displacements on the flat end surface of the concentrators. Calculations of the resonance frequency and the radius of the nodal section agree with experimental results, but the calculated gains are about 20% too high. References 7: 6 Russian, 1 Western.

USSR   UDC 534.833

COMPENSATION OF THE RADIATION OF A FLEXURALLY VIBRATING PLATE WITH STIFFENERS

VYALYSHEV, A. I., and TARTAKOVSKIY, B. D., Acoustics Institute, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] Attenuation of the sound power radiated by an infinite plate with thin stiffeners, acted on by an auxiliary linear force, is examined. The vibration field of the plate was investigated with consideration of the response of the medium; the dependence of power attenuation on the coordinates of application of the primary and compensating forces was determined. It was shown that the attenuation of the sound power achieved at subcritical frequencies depends on the contribution made by the stiffeners to the radiation field of the plate. The optimum distance between the coordinates of application of forces that correspond to the maximum attenuation of the radiated acoustic power was then determined. References 2 Russian.

DAMPING OF A FIELD EXCITED BY A PULSATING SPHERE IN A RECTANGULAR WAVEGUIDE

BOYKO, A. I., and IVANOV, V. P., Acoustics Institute, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The stationary problem of damping of a field excited by a pulsating
sphere in a rectangular, semi-infinite waveguide is examined: the waveguide
is acoustically rigid on the side, end and lower walls and acoustically soft
on the upper wall. Damping is effected by a field excited by a system of
auxiliary spherical radiators arranged in some layer within the waveguide.
The number of radiators, their amplitudes and phase is determined, as well
as the distance from the waveguide end such that the total field of all
radiators first falls below a prespecified small number. References 4
Russian.

SCATTERING OF AERODYNAMIC NOISE BY HARD AND SOFT SURFACES

KRASIL'NIKOVA, T. N.

[Abstract] The author examines the influence of a number of surfaces on the
intensity of different noise components: dipoles and quadrupoles in the main
part of the flow, and viscous stresses on the surface itself. She uses the
method of Green's functions and dimensional analysis. It is found that dif-
fraction effects obviate amplification of the different noise components of
a turbulent boundary layer on hard and soft infinite planes, on fairly smooth
hard and soft surfaces of large wave number and on hard surfaces of small wave
number. The intensity of the dipole component of the radiation generated by
a shift in average frequency is proportional to U_0^6 (where U_0 is the charac-
teristic velocity), and the intensity of the quadrupole component $\sim U_0^8$. At
small Mach numbers, the dipole component predominates over the quadrupole
component. Amplification of the acoustic field of turbulent sound sources
due to conversion of the great part of the energy of the short-range field
to acoustic energy takes place on the sharp edge of hard and soft half-planes
and a wedge, and on a soft sphere of small wave number. The intensity of
dipole and quadrupole components of noise from sources close to the sharp

edge of a hard or soft wedge with outside angle $\pi p/q$ conforms to the relations $I_{dip} \sim U_0^{4+2p/q}$ and $I_{quad} \sim U_0^{6+2q/p}$, while the intensities are proportional to the fouth and sixth powers of the characteristic velocity for dipole and quadrupole components respectively in the case of noise sources close to a small soft sphere. References 11: 5 Russian, 6 Western.

DIFFRACTION OF SOUND BY A WEDGE NEAR AN ELASTIC PLATE

KOROVKIN, A. N.

[Abstract] The problem of the diffraction of a plane acoustic wave by a wedge with ideal faces near a thin elastic plate is examined. The acoustic pressure in the shadow zone beyond the wedge is determined. Each wedge face is assumed either ideally stiff or ideally compliant. The acoustic field is calculated for grazing angles of incidence. The solution is valid if the frequency of the incident wave is smaller than the frequency corresponding to the cutoff frequency for the plate. In this case, when the diffracted wave is reflected by the plate, surface waves are formed. But if the frequency of the incident wave is larger than the frequency corresponding to the cutoff frequency of the plate, when the diffracted wave is reflected by the plate, an exponentially damped wave will be radiated along the plate at an angle arcsin k/k_{fl} to the normal (where k_{fl} is the flexural wave number. This wave must be taken into consideration even at great distances from the plate. References 8: 5 Russian, 3 Western.

AMPLITUDE-PHASE DISPERSIONS OF ACOUSTIC TRANSDUCERS

KOZYREV, V. A., and PAVLOV, R. P.

[Russian abstract provided by the source]

[Text] Experimental values of the standard deviations of sensitivity and phase are presented for a group of acoustic transducers over a wide frequency range. Ratios between these deviations are examined. It is shown that Hilbert transforms can be used to determine phase dispersions from amplitude dispersions. References 5 Russian.

VIBRATION-ISOLATION EFFICIENCY OF A SET OF GROUPS OF ARBITRARY DISCRETE VIBRATION-ISOLATORS BENEATH A VIBROACTIVE BODY

KLYUKIN, I. I., Leningrad Shipbuilding Institute

[Russian abstract provided by the source]

[Text] Expressions are derived for generalized parameters of a vibro-
insulation mounting; the mounting is made up of an arbitrary number of
groups of local vibration-isolators with different geometric and elastic-
dissipative characteristics. Formulas are derived for transfer functions
(with respect to oscillatory force and oscillatory velocity) and the
vibration-isolation of a set of similar vibration-isolators arranged
between a vibroactive body and a foundation with arbitrary impedance. An
example of a calculation relying on these formulas is shown for vibration-
isolators with longitudinal symmetry (elastic interlayers of regular shape);
the calculation showed how the frequency dependence of the vibration-isola-
tion changes with geometric parameters of the interlayers and the body
placed on them, as well as the acoustic impedance of the interlayer
material. References 6: 3 Russian, 3 Western.

DYNAMICS OF A BUBBLE NEAR A SPHERICAL RADIATOR

KUZNETSOV, G. N. and SHCHEKIN, I. YE., Acoustics Institute, Academy of Sciences
USSR, Sukhumi Affiliate

[Abstract] The authors consider motion of a bubble close to a solid spherical
surface that moves in accordance with a given law in an incompressible viscous
liquid. This situation arises when a spherical radiator operates in an unbounded
liquid. It is assumed that the radius of the radiator is much greater than that
of the bubble, and the curvature of the spherical surface is accounted for in
determining the velocity distribution and pressure field, but is disregarded in
determining secondary effects -- the influence that the surface of the sphere
has on parameters of bubble motion. A system of differential equations is
derived for radial oscillations and translational motion of the bubble, and an
expression is found for the force of hydrodynamic interaction between the bubble
and the radiator surface. A solution is found for conditions of cavitation on
the radiator surface. It is shown that the interaction of gas cavitation nuclei
in a liquid with the pressure and velocity pulsations formed by the moving
surface and with their gradients causes directed migration of the nuclei toward

the surface. For this reason there is an increase in concentration of the nuclei close to the surface, causing them to interact and coagulate. In addition, centripetal motion of nonlinearly pulsating nuclei toward the surface of the sphere leads to earlier excitation of cavitations than would be the case in a liquid with initial unperturbed parameters. Therefore in determining the conditions of onset of cavitation on radiators one must consider both the sound pressure gradients and the proximity of the pulsating interface. The significance of these factors will vary depending on the distance of the zone of interference maxima from the surface of the radiators. Under realistic conditions, when this distance is more than a few centimeters the influence of the interface can probably be disregarded and only the structure of the pressure field need be considered. Closer than this, the interface has a considerable effect and cavitation will arise directly on the radiators. References 9: 4 Russian, 5 Western.

CALCULATION OF AN ECHO SIGNAL FROM A NONCIRCULAR CYLINDRICAL SHELL

METSAVEER, YA. A., Institute of Cybernetics, Estonian SSR Academy of Sciences

[Abstract] An algorithm is proposed for calculating the echo signal of a plane acoustic pulse from a thin, noncircular convex cylindrical shell in a liquid medium. Elastic waves in the shell can be described by the theory of Timoshenko type shells, and elastic waves in the medium surrounding these shells can be described by equations of motion of an ideal compressible liquid, given in the acoustic approximation. The algorithm is derived by generalizing formulas obtained for an echo signal from a circular cylindrical shell by the method of integral Fourier transformation with respect to time and Watson's lemma with respect to angular coordinate. The algorithm can be generalized to calculate echo signals from shells that have local inhomogeneities, for example, welds and so on. The simplest case occurs when the inhomogeneity in the shell can be allowed for only by means of coefficients of transmission and reflection of peripheral waves. References 6: 5 Russian, 1 Western.

PROPAGATION OF ACOUSTIC WAVES OF FINITE AMPLITUDE IN AN INHOMOGENEOUS MEDIUM IN THE PRESENCE OF CAUSTIC SURFACES

OSTROVSKIY, L. A., PELENOVSKIY, YE. N., and FRIDMAN, V. YE., Scientific Research Radio Physics Institute, Gor'kiy

[Russian abstract provided by the source]

[Text] Propagation of intense acoustic waves was studied in a medium with a smoothly varying density and pressure. The method of nonlinear geometric acoustics was applied to describe the wave at a great distance from caustic surfaces. The field near these surfaces was pieced together by using formulas of linear theory (Hilbert transforms). The conditions of applicability of this approach are discussed. Transmission of Riemann and shock waves through a caustic surface were studied. It was shown that the diffraction transformation of the shape of the wave on a caustic surface increases the nonlinear attenuation of the reflected wave at large distances. By way of an example, propagation of an intense wave in a laminar medium with a given profile of the speed of sound is examined. References 18: 15 Russian, 3 Western.

MATRIX OF PARAMETERS OF EQUIVALENT SIX-POLE NETWORKS OF COMPLEX PRESSURE-SENSITIVE VIBRATIONAL SYSTEMS

SNYTKO, A. YA. and CHERPAK, V. A.

[Abstract] Matrices of parameters of equivalent six-pole networks are convenient for calculating the electroacoustic parameters of complex vibrational systems of the rod type. The authors describe a method for obtaining such matrices for complex vibrational systems of both series and parallel mechanical coupling between links. Piezoelectric and magnetostriction systems are considered. The analysis consists in breaking down the initial system into unit composite Langevin transducers, and then computing the elements of the matrix for the entire system from the known elements of the matrices of the component links. Matrix parameters are tabulated for the pressure-sensitive elements of a system of two Langevin transducers in four basic arrangements of mechanical and electrical series and parallel connections. An example is given showing how the table can be applied for finding the matrix of active elements of a specific system. It is shown how matrices can be used to find the resonant frequencies of Langevin transducers. References 7: 6 Russian, 1 Western.

RADIATION BY AN INFINITE PERIODIC ARRAY OF OSCILLATING STRIPS IN A PLANE
ACOUSTICALLY COMPLIANT BAFFLE

DOBROVOL'SKIY, YU. YU.

[Abstract] An infinite equidistant array of identical strips, of infinite
length, is assumed to lie in the plane Z = 0 of a Cartesian coordinate
system XYZ; the origin of coordinates coincides with some point on the
midline of one of the strips, and the OY axis is oriented along it. The
angle α that characterizes the direction of cophased emission is read out
from the OZ axis in plane Y=0. Local dimensionless compliance is considered
on the surface of the intermediate baffles that fill out the surfaces of the
radiating strips to make an infinite continuous flat surface. Expressions
are given for the acoustic pressure and emission impedance of the vibrating
strips. Distributions of the amplitude of acoustic pressure at the surface
of the radiating array with compliant baffle and with different strip sizes
are shown. Also given are curves for the active and reactive components of
the radiation impedance as functions of strip width for different baffle
impedances. When the baffle has high compliance (g=10) and the ratio of
strip width to the period of the array is less than 0.5, emission impedance
changes only slightly with a considerable change in the angle α. When the
width-to-period ratio is greater than 0.5 in a compliant baffle, the re-
active component of the emission impedance increases with increasing com-
pliance of the baffle. References 3: 2 Russian, 1 Western.

A MODEL OF ACOUSTIC RADIATION BY A TURBULENT BOUNDARY LAYER ABOVE AN
INHOMOGENEOUS BOUNDARY

KASOYEV, S. G., Acoustics Institute, Academy of Sciences USSR

[Abstract] One mechanism of generating sound by a turbulent boundary layer
at inhomogeneous boundaries and caused by the boundary layer interacting
with inhomogeneities is examined. A plane statistical vortex model of a
turbulent boundary layer is proposed: the layer consists of chains of
identical linear vortices traveling at the same velocity over the boundary.

The distance between the vortices in the chain is a random variable, distributed exponentially. The distribution of parameters in the vortex layer is assumed to be as similar as possible to actual flows: the pattern of random fluctuations in velocity corresponds qualitatively to the concept of turbulent flow. References 8: 6 Russian, 3 Western.

CALCULATING THE ECHO SIGNAL OF A DIRECTED PROBING PULSE FROM A SPHERICAL SHELL

METSAVEER, YA. A., Institute of Cybernetics, Academy of Sciences Estonian
SSR

[Abstract] The problem of calculating an echo signal is described in dimensionless coordinates so that all linear dimensions are determined in units of the radius R of a shell. The dimensionless time τ is given by the formula ct/R, where t is time and c is the speed of sound in the medium. The source of the directed probing pulse is assumed to consist of a large number of elementary point sources located on a disk. An approximate expression is given for the probing pressure pulse from such a source, and it is shown how Fourier transformation with respect to time can be used to calculate the echo signal of this pulse upon arrival at a given point of the shell. The author examines the case where the point of observation is at the center of the source, and the source is located far from the shell compared with the dimensions of shell and source. Reference 1 Russian.

MANY-PHOTON STARK EFFECT IN A DIMENSIONALLY QUANTIZED SEMICONDUCTOR

ARUTYUNYAN, G. M., and NERKARARYAN, KH. V., Yerevan State University

[Abstract] Using a two-band model, a theoretical study is made of the
influence of intraband movement of electrons and holes by a wave field on
restructuring of the wave functions and energy spectrum of a semiconductor
in the presence of the dimensional quantum effect (DQE). An earlier study
has shown that the influence of an intense electromagnetic wave on semicon-
ductors under conditions of saturation in the absorption process leads to
the appearance of an extra gap in the quasi-particle spectrum. This effect
has a number of distinctive features when the electron gas has a quasi-
particle spectrum. This effect has a number of distinctive features when
the electron gas has a quasidiscrete spectrum. Recently this effect has
been of interest from the viewpoint of the feasibility of realizing the
mechanism of high-temperature superconductivity in the presence of this
physical situation. The model used here is that of a film described by a
potential with infinitely high walls. It is demonstrated that taking
intraband movement into account limits the size of the gap in the quasi-
particle spectrum. At the same time, many-photon resonance becomes
possible so that the wave induces not one, but an entire series of for-
bidden gaps in dimensionally quantized bands. Equations are given for
the relationships between the width of the gap and various photon para-
meters. References 6 Russian.

ABSOLUTE QUANTUM YIELD OF LOW-INERTIA ENERGY TRANSFER IN ALKALI-HALIDE
CRYSTALS

NAGLI, L., Latvian SSR Academy of Sciences Institute of Physics

[Abstract] In earlier papers a rapid-response luminescent memory device was
proposed, utilizing alkali-halide crystals. It operated on the basis of the
phenomenon of low-inertia energy transfer from electron color centers ex-
cited by brief light pulses to hole activator centers and subsequent recom-
bination luminescence of the activator. The absolute quantum yield of the
low-inertia energy transfer process is important from the scientific view-
point and its determination is the purpose of this paper. The object of

study was a KCl:In crystal with an In^+ ion concentration of 1.1 X 10^{18} cm^{-3}, 1 mm thick. The method used was to compare the light sums emitted during phase excitation in the A In^+-center absorption band (A scintillation) with the light sums omitted during pulse excitation in the F absorption band (F scintillation) of the crystal studied, x-rayed with different doses. It is possible to determine the absolute quantum yield of low-inertia energy transfer when the absolute quantum yield of In^+ ion emission during excitation in the A absorption band is known, which was determined earlier. Also found was the relationship between the absolute quantum yield of low-inertia energy transfer and the ionizing radiation dose used on the crystal. As the x-raying period increases from 5 to 40 min, the absolute quantum yield drops from 0.3 to 0.1. The value of the yield of the process leading to the origin of recombination activator luminescence pulses is close to unity. This fact proves the hypothesis that the process of low-inertia energy transfer from electron color centers of the base substance to hole activator centers takes place in genetic pairs. Figures 3; references 9 Russian.

THEORY OF NONLINEAR GALVANOMAGNETIC EFFECTS IN ANISOTROPIC MULTIVALLEY SEMI-CONDUCTORS IN AN ELECTRIC FIELD AND A QUANTIZING MAGNETIC FIELD BOTH PARALLEL

CHUYENKOV, V. A., and IDAYATOV, E. I.

[Text] The kinetic equation technique is used to derive corrections that are nonlinear with respect to electric field for longitudinal magnetoresistance in the case of quantizing magnetic fields. The corrections account for electron scattering on acoustic phonons, charged impurity centers and point lattice defects with δ-like potential.

NUMERICAL MODELING OF A ONE-DIMENSIONAL BIPOLAR TRANSISTOR STRUCTURE

MARTUZANS, B., and POL'SKIY, B. S., Latvian State University imeni P. Stuchka
Computing Center

[Abstract] In this paper an efficient iteration method is suggested for
solving one-dimensional steady-state problems of semiconductor device theory.
The problem is formulated proceeding from the system of steady-state equations
describing the distribution of current carrier concentration and electric
field potential in a semiconductor structure in a one-dimensional approxima-
tion. Boundary conditions are formulated for the concentration of electrons
and holes and the electric field potential, drawing on methods suggested in
earlier papers. The formulas used apply to an n-p-n transistor connected in
a common base circuit. A finite difference approximation results in a system
of nonlinear algebraic equations, for the solution of which an iteration pro-
cess is suggested, resulting in an algorithm for computation. The iteration
process used makes a more rapid rate of convergence possible, even in the case
of heavily doped bipolar structures, where one of the iteration parameters, the
time interval, is low and results ordinarily in a slow rate of convergence. The
results are given of calculations for a specific bipolar silicon transistor
structure. A particular calculation required six minutes of machine time,
using the SYe-415 computer, the same calculation having taken 96 min of
machine time before introducing the iteration parameters included here.
An analysis of the choice of iteration parameters and the convergence of
the iteration process is the subject of another paper. Figures 4; references
10: 3 Russian, 7 Western.

PRACTICAL USES FOR GALLIUM ARSENIDE CONTAINING DEEP CENTERS

KHLUDKOV, S. S.

[Text] This is a survey of possible applications for GaAs containing impuri-
ties with deep energy levels, in such radioelectronic and optoelectronic
devices as signal generators and amplifiers, microwave converters, switches,
memory elements, temperature, pressure, or magnetic-field sensors, photo-
receivers, light emitters, electro-optical modulators, and radiation de-
tectors. References 105.

UDC 537.226:537.311.322

DETERMINATION OF THE ELECTROPHYSICAL PROPERTIES OF SEMICONDUCTOR STRUCTURES
ON THE BASIS OF MEASUREMENTS OF THEIR INTRINSIC THERMAL EMISSION

BILENKO, D. I., and TSIPORUKHA, V. D.

[Text] Results are shown of calculations and experimental studies concerning
how the intrinsic thermal energy radiated by a GaAs single crystal depends
on the concentration of charge carriers, and the problem of thermal emission
from two-layer structures and diffusion layers is analyzed.

UDC 537.226:537.311.322

ELECTRICAL PROPERTIES AND STRUCTURE OF ALUMINA FILMS PRODUCED BY OXIDATION
OF ALUMINUM TRIMETHYL

SHITOVA, E. V., GENKINA, N. A., and VODZINSKII, V. YU.

[Text] A study was made of Al_2O_3 films 0.1-0.3 μm thick used in MOS and MOM
structures. The loss tangent tan δ was found to vary within the 0.005-0.01
range and to depend slightly on the frequency below 20 MHz. The dielectric
constant ε was found to vary within the 7.5-8.6 range.

RELATION BETWEEN THERMOELECTRIC AND MAGNETIC PROPERTIES OF CARBONACEOUS
MATERIALS

BAYTINGER, YE. M., KARASOV, V. YU., SHULEPOV, S. V., PEKIN, P. V., and
PESIN, L. A.

[Text] An expression is derived for the temperature characteristic of the
thermoelectromotive force of carbonaceous materials, which qualitatively
describes the approximate relation between the maximum on this characteristic
and the Fermi energy at 0 K. The Fermi energy and the concentration of
current carriers in carbonaceous materials are calculated over a wide range
of heat treatment temperatures (1500-2500°C). The effective mass of charge
carriers is then calculated from this temperature characteristic of the
thermoelectromotive force and from the magnetic susceptibility of car-
bonaceous materials.

ANALYSIS OF THE CONDUCTION AND THE HALL EFFECT IN SEMICONDUCTOR FILMS AND
IN CRYSTALS WITH THE AID OF A SMALL COMPUTER

VETROV, A. P., ONIPKO, A. F., and YANCHUK, Z. Z.

[Text] An apparatus is described which includes a model "PROMIN'-2"
control computer for Hall effect and electrical conductivity (σ) measure-
ments on semiconductor specimens. This computer is programmed for regu-
lating the temperature of specimens in a cryostat, setting the current
through the specimens, controlling the magnet performance, storing in its
memory values of the Hall emf and the conductivity, and for calculating
the Hall constant (R) as well as the carrier concentration and mobility.
Both σ and R of various semiconductor materials were measured with this
apparatus over the 100-400 K temperature range. The results agree closely
with results obtained by other methods of measurement.

ANALOG OF A MOTT JUNCTION IN COMPENSATED GALLIUM ARSENIDE

VUL, B. M., ZAVARITSKAYA, E. I., VORONOVA, I. D., and ROZHDESTVENSKAYA-
KOTEL'NIKOVA, N. V.

[Text] Temperature characteristics of the electrical resistance and of the
Hall mobility were measured in GaAs with a compensation $K=N_aN_d=0.83-0.96$ at
a donor concentration $N = 2.5 \cdot 10^{17}$ cm^{-3}. At a concentration of free electrons
$n_o=N_d-N_a$ above $5 \cdot 10^{16}$ cm^{-3} the resistance is slightly temperature dependent,
corresponding to a degenerate state. At n_o below $5 \cdot 10^{16}$ cm^{-3} within the
10-1.0 K temperature range conduction is due to thermal activation of
donors. This concentration corresponds to a transition from semiconductor
to metallic properties. Measurements of the Hall mobility indicate that
$\mu \sim T^{3/2}$ over the 20-100 K temperature range, which is characteristic of
scattering by a charged impurity. The photoconductivity of a specimen
with $n_o \sim 10^{16}$ cm^{-3} was measured at 1.6 K. The photocurrent has been found
to increase jumpwise at a definite light intensity and this is attributed
to a delocalization of electrons from potential wells, as a result of
shielding of the fluctuation potential by photoelectrons and photoholes.

TEMPERATURE CHARACTERISTIC OF THE ELECTRICAL CONDUCTIVITY OF CARBONACEOUS
MATERIALS

SHERMERGOR, T. D., and AGRIKOV, YU. M.

[Text] The temperature characteristic of the electrical conductivity of
graphitized carbon fibers was measured. The width of the forbidden band
is estimated at 0.1 eV and the length of crystals along the fiber axis is
estimated at 5400 nm.

TEMPERATURE-FREQUENCY CHARACTERISTICS OF THE ELECTRICAL CONDUCTIVITY OF
CARBONACEOUS MATERIALS

SHUVALOV, V. I., PEKIN, P. V., and SHULEPOV, S. V.

[Text] Temperature-frequency characteristics of the electrical conductivity
of carbonaceous materials were measured, after heat treatment at 200-600°C,
over the $3 \cdot 10^2$-$2 \cdot 10^6$ Hz frequency range and from liquid-nitrogen temperatures
to 80-100°C below a given heat treatment temperature. Two mechanisms of
electrical conduction with a transition region are suggested, and their
respective temperature-frequency ranges of action are defined.

TEMPERATURE-FREQUENCY CHARACTERISTICS OF THE DIELECTRIC PROPERTIES OF
CARBONACEOUS MATERIALS

SHUVALOV, V. I., PEKIN, P. V., and SHULEPOV, S. V.

[Text] A dispersion of the dielectric constant of calcined carbonaceous
materials has been established. The value of the loss tangent has been
found to depend on transmitted as well as polarization losses. The activa-
tion energy E of the polarization process is calculated from data covering
the 200-600°C range of heat treatment temperatures. This energy is found
to decrease with higher treatment temperatures.

CRYSTAL STRUCTURE OF THE SYNTHETIC SODIUM–IRON–ZINC ORTHOPHOSPHATE
$Na_{2-x}Zn_xFe_3[PO_4]_2(OH)_{2-x}O_x$, x = 0.1
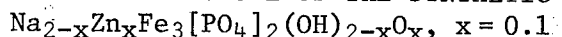
YAKUBOVICH, O. V., SIMONOV, M. A. and BELOV, N. V., academician

[Abstract] Crystals of synthetic sodium-iron-zinc orthophosphate were ob-
tained at the Laboratory of Hydrothermal Synthesis of the Institute of
Crystallography, Academy of Sciences USSR in a study of the $NaCl-ZnO-(NH_4)_2-$
HPO_4-H_2O system. With specific weight of 3.71 g/cc in the rhombic cell with
lattice parameters a = 8.429 ± 0.002, b = 6.529 ± 0.001, c = 14.605 ± 0.003 Å
there are two units of the approximate composition $Na_4ZnFe_5P_4O_{18} \cdot 1.5H_2O$.
The experimental specimen was a spherical crystal 0.4 mm in diameter
analyzed by the $2\theta-\theta$ method at a scanning rate of 6-24 deg/min on an
autodiffractometer giving 1640 independent non-zero ($I \geqslant 3\sigma I$) reflections.
Translation of intensities to $|F_{hkl}|$ with consideration of absorption ($\mu_r = 1.5$)
and subsequent calculations were done in the "Kristall" complex of the BESM-4M
computer. The decoded structure of $Na_{1.9}Zn_{0.1}Fe_3[PO_4]_2(OH)_{1.9}O_{0.1}$ was similar
to the structure of natural Mn,B,P-simanite $Mn_3^{2+}[B(OH)_4][PO_4](OH)_2$. The
lattice constants are close for the two phosphates, both have a rhombic cell
and triplets with $mm2$ symmetry consisting of three octahedra connected along
the edges. References 6: 4 Russian, 2 Western.

Electricity and Magnetism

GENERATION OF CIRCULARLY POLARIZED ELECTROMAGNETIC RADIATION

ALFEROV, D. F., BASHMAKOV, YU. A., and BESSONOV, YE. G., Physics Institute
imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Russian abstract provided by the source]

[Text] Circular polarization of the radiation of particles traveling in
a helical trajectory at relativistic longitudinal velocities is investigated.
For an optimal transverse particle velocity, the radiation has high circular
polarization. To generate circularly polarized radiation over a wide spectral
range, a device shaping the transverse magnetic field in which charged parti-
cles move in a helical line is proposed. The device can also generate linearly
polarized electromagnetic radiation. References 7 Russian.

RELAXATION OF THE SURFACE CHARGE ON ELECTRETS DURING PRESSURE CHANGES

LISITSYN, V. M., OLESHKO, V. I., and SELEZNEV, V. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 10 (II), Abstract No 10E881 DEP by
the authors]

[Text] A study was made of the relaxation of the surface charge on corono-,
tribo-, and radioelectrets during changes in the ambient gas pressure around
these materials. It has been established that, regardless how such a
relaxation is achieved, this process is a pulsating one and accompanied by
electromagnetic radiation pulses within both the visible and the r-f range
of the spectrum. The relaxation time τ is 500 ± 50 µs for a light pulse and
200 ± 20 µs for an r-f pulse.

INVESTIGATION OF CURRENT DISTRIBUTION IN A DISCHARGE GAP WITH SLIT DIAPHRAGM

SHADRIN, N. I.

[Text] An investigation was made of the principles that govern current distri-
bution in the slit opening of a diaphragm in the pressure range of 0.05-0.6 mm Hg.
It is shown that the maximum density of the discharge current at high pressures
is localized in the middle sections of the diaphragm slit, while at low pres-
sures the current alternates between opposite edges of the slit over the duration
of the current pulse.

INVESTIGATION OF THE VOLTAGE DROP IN THE VICINITY OF A HIGH-FREQUENCY DISCHARGE
ADJACENT TO POINTS OF APPLICATION OF EXTERNAL ELECTRODES

KOLGIN, YE. A. and POTSAR, A. A.

[Text] The effective voltage drop in the edge regions of a radio-frequency
discharge that are adjacent to a dielectric shell at points of application of
external electrodes are experimentally and theoretically determined. The best
agreement between the results of calculation and experiment for helium takes
place at pressures above 1.5 mm Hg. It is pointed out that analogous results
are observed for neon, argon and xenon as well.

RUNNING COMPUTATION SCHEMES FOR HYPERBOLIC SYMMETRIC SYSTEMS

PINCHUKOV, V. I.

[Text] Two two-step implicit absolutely stable difference schemes are con-
structed for hyperbolic symmetric systems of equations of first order. One of
these difference schemes has second-order approximation with respect to all
variables. The schemes can be realized by the multidimensional "running com-
putation" method. The stability of the schemes is proved by the energy ine-
quality method. One of them was applied to calculation of nonequilibrium two-
dimensional flow of an ideal gas in a Laval nozzle for the case of oscillatory
relaxation. The grids used were 8 x 32 and 16 x 64 (with respect to coordinate
and time). On the first grid the deviation of enthalpy from the known constant
value was no more than 0.5%, and on the second -- 0.2%. The difference between
the maximum and minimum values of flowrate (which should be constant) did not
exceed 4-6 and 3-4%. As a rule, the difference between solutions on different
grids did not exceed 2-3%, and only close to a line, where the velocity is
equal to the speed of sound, do additional first-order terms appear and the dif-
ference rises to 6-8%. The time for solution (80 time steps) on the BESM-6
computer is 16 minutes.

INFLUENCE OF POLYMER ADDITIONS ON REDUCTION OF FRICTION IN TURBULENT FLUID
FLOWS

STAROBINTSEV, G. L., associate member, Belorussian SSR Academy of Sciences,
and STAROBINTSEV, G. G., Belorussian State University imeni V. I. Lenin

[Abstract] Excessively diluted solutions of polymer substances often possess
eddy-viscosity resistance which is considerably lower than that of the pure
solvent. Previous studies of the possible mechanism for this phenomenon have
not paid attention to the energy expended by the normal component of the

turbulent flow in forming voids in the structure of the water or other solvent when hydrophobic chains of macromolecules move from the boundary adsorption phase near the rigid wall into the volume of the solution. The purpose of this paper is to demonstrate the interrelationship of two effects: Reduction of friction in solutions of polymers, and the energy expended to form a void in this solvent. A close relationship has been observed between the effect of reduction of friction in aqueous solutions of high-molecular substances and the adsorption of these substances at the rigid wall -- solution interface, for both effects ,pass through a maximum depending on the volume concentration of the high-molecular substance. Previous studies advanced the idea that the spontaneous occurrence of adsorption of organic substances at the phase interface is due to hydrophobic interaction, whose dominant component is the energy gain of the void, when hydrophobic parts of molecules pass from the volume of the diluted solution into the more concentrated boundary phase. A mechanism is suggested which explains well the experimental data thus far obtained and agrees well with an adsorption model from an earlier study. According to this mechanism the effect of reduction in friction will be most pronounced in the range of concentration of polymer solutions close to ideal when the polymer exists in the volume of the solution in the form of single molecules, and in the adsorption phase in the form of associates. With polymer concentrations exceeding the critical micelle-formation concentration association occurs in the volume of the solution almost as intensely as near the wall, the void energy becomes slight, and the polymer solution shows a negligible influence on friction. Reduction of friction is at a maximum with a polymer concentration less than the critical micelle-formation concentration. It is emphasized that the relationship between the effect of reduction in friction and concentration has not been explained in previous theories. References 13: 9 Russian, 4 Western.

AVANESOV, A. M., AVETISYAN, I. A., and LISTROV, A. T., Acoustics Institute, Academy of Sciences USSR, Sukhumi Branch

[Russian abstract provided by the source]

[Text] Numerical calculations are made of the nonlinear motion of the boundary of a spherical bubble pulsating in an unbounded volume of incompressible viscoelastic liquid, acted on by a periodic pressure field

and dilatational field of specific extent. It was shown that in a visco-
elastic medium, the bubble pulsates with smaller maximum velocities than
in a Newtonian liquid. Amplitudes of bubble oscillation in the dila-
tational field and at certain frequencies in the periodic pressure field
decrease. It was also found that the viscoelastic properties of polymer
solutions reduce the natural frequency of bubble pulsation. A possible
interpretation is given for experimental findings on the slowing down of
the onset of cavitation and reduction in the intensity of cavitation noise
when polymer additives are introduced into water. References 18: 13
Russian, 5 Western.

Lasers and Masers

ON THE FEASIBILITY OF DEVELOPING SYSTEMS FOR AUTOMATIC ALIGNMENT OF LASERS
WITH UNSTABLE CAVITIES

KUPRENYUK, V. I., RYBALKO, I. O., SHEBANOV, B. A. and SHERSTOBITOV, V. YE.

[Abstract] The mirrors of laser cavities get out of alignment during oper-
ation for various reasons. In this paper the authors discuss the possibility
of making automatic alignment systems. Precision actuating devices are avail-
able for angular displacement of the mirrors, and therefore the problems re-
duces to generation of a control signal proportional to the amount of mis-
alignment. This problem is examined from the standpoint of unstable cavities,
which are in wide use in various types of gas lasers. The usual method of
automatic alignment is based on the way that the symmetry of stimulated emis-
sion depends on the degree of misalignment, which is not applicable to the
class of lasers considered. A way around the problem is to use an auxiliary
laser with a wavelength that does not lie in the bands of absorption or ampli-
fication of the active medium. Ways to couple the auxiliary laser emission
along the axis of the working laser are discussed. Parameters are determined
for an automatic alignment system based on this principle. The "lock-in"
range for the proposed system is within $2.04 \cdot 10^{-3}$ rad. Due to adverse experi-
mental conditions, the noise level in the zero difference signal was about
50 mV, corresponding to a limiting precision of $4.85\text{-}5.82 \cdot 10^{-5}$, which can be
improved to $2.42\text{-}2.91 \cdot 10^{-5}$ rad by mounting on rubber shock absorbers. In the
unlikely event that even better precision is required, the influence of the
unstable cavity on the cavity of the auxiliary laser can be eliminated by
introducing a nonreciprocal device (quarter-wave plate and polarizer) into
the gap between the cavities. The alignment system operates at a rate of
$1.5 \cdot 10^{-3}$ rad/s. References 2 Russian.

RELATING AND OPTIMIZING THE PARAMETERS OF A NANOSECOND LASER-PULSE PHOTO-
STIMULATION UNIT

TIBILOV, S. S., candidate of sciences

[Abstract] Based on analysis of optical arrangements of the pumping system
as well as the registration system in studying the method of nanosecond

laser-pulse photostimulation (NLPP) the author finds conditions of maximum
sensitivity and maximum pumping (assuming constant pumping energy and linearity
of the processes taking place in the system). It is shown that these con-
ditions cannot be satisfied simultaneously. An optimum combination of such
conditions is proposed. A general estimate is made of the sensitivity of the
NLPP method based on the parameters of currently existing devices, and a
value of 1.0% is found with respect to transmission for kinetic measurements,
with a corresponding value of a few percent for spectral measurements. A
number of expressions are found that relate the parameters of the substance
investigated to the parameters of the equipment used in the NLPP installation
with maximum permissible optical density of the induced absorption. Refer-
ences 11: 9 Russian, 2 Western.

KUKHTO, A. N., Moscow

[Abstract] A method is proposed for calculating a multiple-frequency flat
cavity for a gas dynamic CO laser. The computational procedure is based on
energy balance equations with respect to all possible frequencies of stimulated
emission. On the basis of this method and analytical calculations of kinetic
processes in the nozzle the author examines the operation of a gas dynamic
CO laser as a whole, reducing calculations to determination of output power.
The calculated energy characteristics are compared with experimental data.
The basic calculations were done for a conical axisymmetric nozzle with
semivertex angle of 7.5°, diameter of the critical cross section of 0.884 cm,
length of 73.4 cm and area ratio of $F/F_{cr} = 512$. The model of the optical
cavity used is described for a resonator made up of two parallel flats
separated by a distance d in a gas stream of extent l, one of the flats having
a certain transmission factor. Assuming that the electromagnetic field dis-
tribution depends only on the z-coordinate along the mirrors, the problem is
reduced to a one-dimensional case. Calculations showed that the proposed
cavity can generate radiant energy even when the distance between mirrors is
short and energy losses are high. For absorption losses of 4-8% in the mirrors
the optimum output power with respect to transparency occurs in the range of
a 10% transmission factor. Emission spectra are calculated for different
Co:Ar gas mixtures. The results of comparison with experimental data show that
the proposed model of kinetic processes in the cavity and the assumed particu-
lars of the oscillatory kinetics in the nozzle with consideration of anharmo-
nicity give a qualitatively correct description of the operation of a gas
dynamic CO laser. References 10: 2 Russian, 8 Western.

INFLUENCE OF LASER EMISSION FIELD ON THE COLLISION-BROADENED SHAPE OF THE
H_2O ABSORPTION LINE

ZUYEV, V. YE., associate member of the Academy of Sciences USSR, LOPASOV,
V. P. and PONOMAREV, YU. N., Institute of Optics of the Atmosphere, Siberian
Department, Academy of Sciences USSR, Tomsk

[Abstract] A report on an experimental study of the contour of the H_2O
absorption line with center at 694.38 nm (transition 4_{-3}-5_4 of band
000-103) for the case of N_2 and CO_2 broadening as a function of the
intensity of laser emission. The spectral coefficient of absorption $k(\nu)$
was measured on an acoustico-optic spectrometer including a spectrophone,
a frequency-tunable monopulse ruby laser with emission line width of 0.04 cm^{-1}
and a system for recording laser emission parameters. The H_2O absorption line
contour was measured at laser emission intensities of 5 and 35 MW/cm^2. In
the case of nitrogen broadening, there is a reduction of absorption by a
factor of about 1.5 in the line center with only slight reduction in absorp-
tion at the edges of the line. For intensity of 35 MW/cm^2, carbon-dioxide
broadening caused no reduction in absorption at the center of the line, and
the reduction at the edges increased with distance from the center. The
difference in behavior is attributed to the much lower probability of
vibrational-vibrational energy exchange for the H_2O-N_2 system than for the
H_2O-CO_2 system. References 7: 6 Russian, 1 Western.

INFLUENCE THAT NONEQUILIBRIUM CHEMICAL PUMPING HAS ON AMPLIFICATION OF EMISSION
OF A CO_2 LASER IN PRODUCTS OF REACTION OF $CO + N_2O$

KUDRYAVTSEV, N. N., NOVIKOV, S. S. and SVETLICHNYY, I. B., Institute of
Chemical Physics, Academy of Sciences USSR, Moscow

[Abstract] A systematic comparison is made of the amplification factor of
monochromatic emission with wavelength $\lambda = 10.6$ μm in a supersonic expanding
flow of products of reaction of carbon monoxide with nitrous oxide for
$5N_2O + 25CO + 70$ He (mixture 1) and $5CO_2 + 20CO + 5N_2 + 70He$ (mixture 2). The
second mixture corresponds to the products of complete reaction of the first.
An investigation was also made of the influence that partial replacement of
the helium in the first mixture by nitrogen has on the way that gain depends
on temperature preceding the nozzle. It was found that the gain for the

reacting first mixture at temperatures of 1500-2000 K considerably exceeds that for the final reaction products (mixture 2). Results of a study of spontaneous emission on the wavelength of fluorescence for recombination of CO + O show intense recombination fluorescence in the flow of reacting products below 2200 K and none at all in the unreacting mixture. This is direct evidence of intermediate products of the reaction of CO + N$_2$O in the expanding supersonic flow. A change in temperature dependence of gain when part of the helium is replaced by nitrogen can be explained by the particulars of the kinetics of vibrational relaxation in laser-active mixtures based on CO $\rightarrow$ CO$_2$ oxidation. References 8: 5 Russian, 3 Western.

SHLYAPNIKOV, G. V., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] The coefficient of absorption of molecular gas in the infrared region consists of a large number of spectral lines, each of which corresponds to a certain vibrational-rotational transition. At high gas pressures the line width is large compared with the distance between adjacent lines, so that the coefficient of absorption is a continuous function of frequency. At low pressures the reverse is true and the frequency dependence of the coefficient of absorption becomes oscillatory. If this dependence is approximated by a rapidly oscillating function multiplied by a smooth frequency function, a relation can be found in the case of a lorentzian spectral line for the frequency-integrated flux of emission of a plane layer of gas of linear molecules as a function of a typical parameter of the problem -- the maximum value of the envelope traced through the minima of the optical thickness of the layer (the maximum optical thickness at the minimum).

An analogous calculation is given in this article for a spectral line of arbitrary shape. Simple expressions are found that relate the frequency-integrated flux of emission of a plane layer of gas to line shape for high values of the maximum optical thickness of the layer at the minimum. The results are tabulated for Doppler, lorentzian and power-law lines. The proposed formulas enable fairly easy calculation of the frequency-integrated emission flux for a plane layer, and they can be extended to the case of a layer of variable temperature. References 4 Russian.

SELECTION OF PUMPING MODE IN INJECTION LASER IN OPTICAL COMMUNICATION LINES

ALFEROV, ZH. I., PORTNOY, YE. L., PRINTSEV, YE. V., and RUDOV, YU. K.,
Physicotechnical Institute imeni A. F. Ioffe, USSR Academy of Sciences,
Leningrad

[Abstract] Recommendations are worked out for determining the optimal
pulsed pumping mode of an injection laser when the limitation of thermal
power scattered in the laser body is the primary constraint. Also, the
effect on choosing the regime of parameters such as threshold current,
spontaneous lifetime of injected carriers and constant bias current, is
estimated. A laser with plane geometry made by oxygen implantation based
on the double heterostructure $Al_xGa_{1-x}As$ was used. Laser operation in
communication lines at these data transmission rates was analyzed: 8.448
mbits/sec, 120 telephone channel capacity, 34.816 mbits/sec, 480 telephone
channel capacity and 114.048 mbits/sec, 1440 telephone channel capacity.
An optimal pumping mode (ratio between duration of current pulse and its
amplitude) was found at which the pulse energy of the semiconductor laser
radiation is at a maximum for a given transmission rate. Semiconductor
laser efficiency was found strongly affected by parameters such as series
resistance and spontaneous lifetime of injected carriers. Applying a
direct bias current may reduce the maximum radiation pulse energy, but
reduces requirements for the source of pumping current pulses. References
6: 4 Russian, 2 Western.

Magnetohydrodynamics

INVESTIGATION OF ELECTRODE METHODS OF MEASURING THE ELECTRICAL CONDUCTIVITY OF
COMBUSTION PRODUCTS

ALEMASOV, V. YE., POTAPOV, G. P., ZIYATDINOV, R. KH., BUGAYENKO, A. G. and
PETRIK, M. M.

[Text] The paper presents the results of comparative measurements of the elec-
trical conductivity of combustion products by an electrode method with respect
to the alternating and direct components of currents when square-wave voltage
pulses are applied to the electrodes. The range over which the measurement
results coincide depends on the concentration of potassium in the additive
solution. It is found that the pulse current shape depends on pulse amplitude.

INFLUENCE OF AN EXTERNAL ELECTRIC FIELD ON FORMATION OF FINELY DIVIDED CARBON
IN THE PLASMA OF A HYDROCARBON FLAME

NESTERKO, N. A. and TARAN, E. N.

[Text] The influence of an external electric field on the emission intensity
of the carbon particle continuum is studied in a low-pressure colliding-jet
acetylene-air flame. The mobility of electrons and positive ions in the flame
is measured. The mobility of positive ions at 20 mm Hg and 1620 K is 565 $cm^2/V\cdot s$,
while that of electrons is $1.4\cdot10^5$ $cm^2/V\cdot s$. The mobility of positive ions
dropped noticeably with the formation of solid carbon. The application of an
external electric field to the flame led to an appreciable reduction of intensity
of the continuum. The mechanism of formation of solid carbon in the flame is
discussed on the assumption that complex $C_mH_n^+$ ions are centers of condensation
of solid carbon.

SPATIAL STRUCTURE OF A SUPERSONIC ISOTHERMAL FLOW OF Ar-Cs PLASMA WITH STRONG
MHD INTERACTION

BARANOV, V. YU., VEDENOV, A. A., KULESHOV, V. P., LYUBIMOV, B. YA., MALYUTA,
D. D. and MEZHEVOV, V. S., Institute of Atomic Energy imeni I. V. Kurchatov

[Russian abstract provided by the source]

[Text] An investigation is made of the way that a hypersonic flow of argon-
cesium plasma is slowed down by a magnetic field. The conditions of the
experiment are such that a direct compression shock is set up in the channel.
A detailed examination is made of the change in flow structure due to this
compression shock. The authors find the change in Mach number in the channel
due to electrodynamic deceleration with respect to the measured components of
the currents, fields and pressure. Problems are discussed that are related
to the existence of weak indirect shocks due to current concentration on the
edges of the electrodes. An estimate is made of the influence that the
degree of sectionalization has on flow perturbation in indirect shocks.
References 5: 3 Russian, 2 Western.

INFLUENCE THAT A HIGH-FREQUENCY ELECTROMAGNETIC FIELD HAS ON THE DEVELOPMENT
OF HOT-SPOT INSTABILITY IN A WEAKLY IONIZED GAS DISCHARGE PLASMA

RAKHIMOVA, T. V. and RAKHIMOV, A. T., Scientific Research Institute of Nuclear
Physics, Moscow State University imeni M. V. Lomonosov

[Abstract] An examination is made of the effect that a radio-frequency elec-
tric field has on development of hot-spot instability in a weakly ionized
plasma in a cavity discharge where the electron concentration is determined
by ionization and recombination of charged particles in the plasma. The mag-
nitude of the rf electromagnetic field relative to the gas discharge field
strength is determined where the rf field begins to influence the increment
of development of hot-spot instability. It is shown that the development of
hot-spot instability is inhibited by the simultaneous action of rf and dc
electric fields. The frequency of the alternating field must be greater than
10^3-10^4 Hz for gas pressure in the discharge of the order of 100 mm Hg and
characteristic dimension of the plasma region of the order of 1 cm. Refer-
ences 3: 1 Russian, 2 Western.

INTERACTION OF PLASMA WITH SURFACE OF A SOLID. 1. IMPINGING OF A SUPER-
SONIC FLOW ON BODIES OF DIFFERENT PROFILES

DEMCHENKO, P. A., and KRUPNIK, L. I.

[Abstract] Characteristics of the glow induced around bodies of different
profiles (plane, sphere, cone and others) when inserted in a supersonic
plasma jet were investigated. The bodies were metallic. Residual gas
pressure in the system was $5 \cdot 10^{-7}$ mm Hg. The plasma detector generated
pulsed plasma flows with duration of 35-40 μs. The flows were characterized
by nonuniform lengthwise structure of particle density. In most injector
operating modes several charged particle density maxima (bunches) were
observed. Absolute particle velocity ranged from 0.3 to $1.0 \cdot 10^7$ cm/s;
this corresponds to a mean energy of bombarding hydrogen ions E_0 = 5-50 eV.
Density of the plasma striking the target varied in the range $5 \cdot 10^{12}$-$5 \cdot 10^{14}$
particles/cm^3. At densities $n^+ < 10^{14}$ particles/cm^3, the glow was concen-
trated at the body surface and existed only where direct incidence of
particles on the target was observed. At higher densities, glow fronts
formed, diverging from the bodies in the flow direction. The glow region
about the flat target was found to be 2.5-3 cm. Two modes of interaction
were recorded: when the wavelength of the ion mean-free path with respect
to Coulomb collision processes was greater than the characteristic dimension
D of the perturbing body, and when the mean-free path length was smaller
than D. References 19: 17 Russian, 2 Western.

A MIRROR TRAP WITH ROTATING PLASMA

PANASYUK, V. M. and TSEL'NIK, F. A.

[Text] The paper examines a version of a mirror trap with crossed fields in which plasma density increases weakly with radius. It is shown that this does not impair stability with respect to drift oscillations. In the proposed design the electric field intensity on the electrodes can be considerably reduced.

DIFFUSION OF A GLOW-DISCHARGE PLASMA

SHMYREVA, L. N.

[Text] Solutions are found for the problem of diffusion of plasma particles in cylindrical systems bounded by three kinds of walls -- dielectric, uninsulated metal and insulated metal. The theoretical curves match satisfactorily with experiment.

ELEMENTAL ANALYSIS OF VANADIUM AND TITANIUM PHOSPHATES BY THE METHOD OF ACTIVATION ANALYSIS WITH FAST NEUTRONS

VAIVADS, J., GEDROVICS, J., KONSTANTS, Z., and PELEKIS, L., Latvian SSR Academy of Sciences Institute of Inorganic Chemistry and Institute of Physics

[Abstract] Wide use is being made of phosphate compounds of vanadium and titanium for the manufacture of materials such as inorganic ion exchangers, pigments, phosphate binders, and semiconductor oxide glass. But methods of chemically analyzing these compounds are complicated and labor intensive and require that most of these compounds be dissociated, and they are difficult to dissolve. Furthermore, these methods result in total destruction of the specimen and do not make it possible to determine the oxygen content, whose variation is used to describe the redox processes which occur in the synthesis of various phosphates. Here a study is made of the use of the neutron activation method of analysis as a nondestructive and convenient approach. Neutron generators have been little used hitherto in determining phosphorus, vanadium, and titanium, and there is no published data available on a complete analysis of a specific specimen for all its macrocomponents by the neutron activation analysis method. It is possible to make an elemental analysis of phosphate compounds of vanadium and titanium by using a fast-neutron generator operating at 14 MeV, resulting in a neutron flux density not exceeding 10^7 n/cm^2/s. High-power neutron sources (nuclear reactors) are thus not required to determine macroquantities of titanium, phosphorus, oxygen, and vanadium. An analysis was made of vanadium and titanium phosphates synthesized by thermal interaction between ammonium dihydrophosphate and vanadium oxide or titanium oxide. The accuracy of the method depends to a considerable extent on how closely the neutron flux is monitored. Measurements were made with a Ge(Li) gamma spectrometer with a 1024-channel analyzer. All measurements were processed with a BESM-4 computer. A comparison is made between the analysis results obtained by chemical analysis and activation analysis with fast neutrons. Chemical analysis is certainly more precise (within one percent, as compared with four percent), but activation analysis is time-saving and provides satisfactory accuracy. This method is recommended both for analyzing some macrocomponents and for making a complete analysis. Figures 1; tables 2; references 23: 14 Russian, 9 Western.

USSR

EFFECT OF TRAPPED ELECTRONS ON ALFVEN WAVES IN A TOKAMAK

MIKHAYLOVSKIY, A. B., and SHUKHMAN, I. G., Institute of Atomic Energy imeni I. V. Kurchatov

[Russian abstract provided by the source]

[Text] The interaction between Alfven waves and trapped electrons in a plasma in a toroidal magnetic field is investigated theoretically. For a finite ratio of plasma pressure to magnetic field pressure, there may be a buildup of waves by this interaction. The buildup increment is determined by the compressibility of the trapped electron gas and also by effects associated with the finite value of the longitudinal electric field of the perturbations. The phenomena studied are of interest for the problem of thermonuclear tokamak reactors and for the physics of the magnetospheric plasma. References 15: 9 Russian, 6 Western.

USSR

EXPERIMENTAL STUDY OF EXCITATION MECHANISMS OF PLASMA WAVES AND THE GENERATION OF HARMONICS IN A PLASMA PRODUCED BY STRONG LASER PULSES

ALEKSANDROV, V. V., ANISIMOV, S. I., BRENNER, M. V., VELIKHOV, YE. P., VIKHAREV, V, D., ZOTOV, V. P., KOVAL'SKIY, N. G., PERGAMENT, M. I., and YAROSLAVSKIY, A. I.

[Russian abstract provided by the source]

[Text] The mechanism of interaction between laser radiation (λ = 1.06 µm) and a high-temperature plasma was investigated, at light flux densities of 10^{12} to $4 \cdot 10^{14}$ W/cm^2. Comparison of results by different techniques showed that at light flux densities exceeding $\sim 10^{13}$ W/cm^2, the effective absorption of radiation is caused by the buildup of decay instabilities t → p + S and t → p + p. Radiation from the plasma on a frequency of 3/2 ω_0 was found to stem from Raman scattering on plasma waves at frequencies close to ω_0/2. Experimental values of threshold densities of the light flux obtained on targets of different materials agree closely with predictions from theory. References 20: 7 Russian, 13 Western.

USSR

HEATING OF IONS WHEN A RELATIVISTIC ELECTRON BEAM IS INJECTED INTO A PLASMA

KOYDAN, V. S., and ROGOZIN, A. I., Institute of Nuclear Physics, Siberian Division of the Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The distribution function and the number of heated ions occurring when a relativistic electron beam is injected into a plasma were experimentally studied. A $\sim$1 MeV beam, current 7-10 kA, duration $\sim$ 70 ns, was injected into a plasma with density $3 \cdot 10^{12} - 4 \cdot 10^{14}$ cm^{-3}, in a magnetic field of $(4.8-9.6) \cdot 10^5$ A/m. Ion heating was investigated by analyzing the fast neutral charge exchange particles escaping from the plasma across the magnetic field. The shape of the distribution function and the number of heated ions were found to depend heavily on the density of the initial plasma. At a plasma density $n > 10^{14}$ cm^{-3}, the distribution function of ions in the energy range studied is near-Maxwellian, and the density of heated ions is $10^{-3} - 10^{-4}$ of the total ion density. When the plasma concentration was lowered ($n < 10^{14}$ cm^{-3}), the distribution function begins to differ from the equilibrium value, and the number of heated ions increases and reaches 10-20 percent of the total number of ions. At reduced densities, the distribution function can be interpreted as a "two-temperature" function, but obviously the distribution of all plasma ions in all modes has a shape differing from the equilibrium shape. At high densities ($n > 10^{14}$ cm^{-3}), ion heating occurs in the space occupied by the electron beam. When the plasma density is lowered ($n < 5 \cdot 10^{14}$ cm^{-3}), ion heating is observed now throughout the plasma pinch. Possible mechanisms of ion heating are discussed. References 15: 9 Russian, 6 Western.

USSR

STUDY OF LASER-DRIVEN IMPLOSION OF HOLLOW MICROSPHERES

BASOV, N. G., ZAKHARENKOV, YU. A., ZOREV, N. N., KOLOGRIVOV, A. A., KROKHIN, O. N., RUPASOV, A. A., SKLIZKOV, G. V., and SHIKANOV, A. S., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Abstract] A nine-channel laser interacting with hollow microspheres was investigated. Laser energy reached 150 J, with light pulse duration of about 2.5 ns and rise time of the order of 0.5 ns or less. The assembly

had a spatial resolution of $\sim$10 lines/mm. The electron temperature of the plasma was determined by the ratio of the number of x-ray quanta passing through beryllium filters of different thickness. Measurements showed that for solid glass microspheres 100-200 μm in diameter these ratios agree well with the ratios for an equilibrium plasma at an electron temperature $T_e \sim$ 250-350 eV. But for hollow microspheres of the same diameter, the electron temperature usually was $T_e \sim$ 300 eV, for filters 300 and 500 μm thick, and $T_e \sim$ 600-700 eV for filters 300 and 700 μm thick. Estimates show that not less than 10^3-10^{-2} J was reradiated by the plasma in the X-ray range and evidently this value does not markedly influence the energy balance. References 29: 13 Russian, 16 Western.

EFFECT OF ELECTRON BEAM PARAMETERS ON PROPERTIES OF UNDULATOR RADIATION

NIKITIN, M. M., and EPP, V. YA., Scientific Research Institute of Nuclear Physics at the Tomsk Polytechnic Institute imeni S. M. Kirov

[Abstract] The dependence of angular-spectral and angular-polarization characteristics of undulator radiation on the distribution of amplitudes and particle oscillation frequency in an accelerated bunch was studied. The undulator radiation was associated with the scatter of electrons with respect to directions of motion in the undulator caused by particle oscillations in the accelerator. The influence of betatron oscillations on the properties of undulator radiation is determined by the parameters $\eta_y = \sigma_y/\sqrt{1 - \beta_0^2}$ and $\eta_z = \sigma_z/\sqrt{1 - \beta_0^2}$ (σ_y and σ_z are the variances of electron distribution with respect to directions of motion and $\beta_0 c$ is the electron drift velocity in the undulator). When $\eta_y \gtrsim 1$ and $\eta_z \gtrsim 1$, betatron oscillations of electrons strongly modify the spectral and angular-polarization distribution of radiation in a laminar particle beam. References 14 Russian.

EXPERIMENTAL STUDY OF SELF-ACCELERATION DURING INTERRUPTION OF AN INTENSE
ELECTRON BEAM

GRISHAYEV, I. A., ZAKUTIN, V. V., NASONOV, N. N., SHENDEROVICH, A. M., and
RAKITYANSKIY, A. A., Physicotechnical Institute, Ukrainian SSR Academy of
Sciences, Khar'kov

[Abstract] An experimental study was made of self-acceleration when the
accelerating system is excited by the trailing edge of a current pulse from
an intense electron beam, intended to more than double beam acceleration.
An oscillatory circuit was used as the resonator. Self-acceleration of a
beam with a current of 0.5-1 kA was achieved during beam interruption. The
maximum energy of the accelerated beam (360 keV) was more than three times
the maximum energy of the initial beam (110 keV). Registration of acceler-
ated particles and their energy determination were made from the strength of
the current of the beam passing through a foil. Foils were of aluminum, 100
and 200 μm in thickness. Most convenient was the 100 μm foil, virtually
blocking a beam with an initial energy of 110-130 keV. Particles with
smaller initial energy were intensified much more (up to eight times). An
analysis was made of the way that the energy increment depends on time during
a pulse. From 13 to 27% of the beam particles were accelerated in the ex-
periments. The integral energy of all accelerated particles reached 25% of
the total energy of the initial beam. A theoretical study was done on the
self-consistent problem of interaction between the beam and the tank circuit.
It was found that in this case the current is approximated with a high degree
of accuracy even for considerable deceleration of particles. The measured
amplitude and shape of the current pulse of the beam of accelerated particles
passing through the foil, as well as the parameters of the accelerating
voltage and the time dependence of the beam energy increment agree with
the calculations. References 12: 9 Russian, 3 Western.

CHARACTERISTICS OF He^3 ISOTOPIC GAS PLASMA GENERATED BY PRODUCTS OF THE
REACTION $He^3(n, p)H^3$ IN A NUCLEAR REACTOR

BATYRBEKOV, G. S., KUZNETSOV, YU. D., PEL'MENSHTEYN, B. YA., and TAKIBAYEV,
ZH. S.

[Abstract] Direct diagnostics of He^3 plasma formed by products of the
reaction $He^3(n, p)H^3$ in a reactor was investigated in the pressure range
of 25-300 mm Hg, with thermal neutron flux from 10^{13} to $2 \cdot 10^{14}$ neutrons/cm^2·s.
The gas samples was placed in a stainless steel ampule, with no uranium

layer on the walls. The ampule assembly was loaded into the central channel of the core of a VVR-K water-moderated water-cooled reactor. At helium pressures to 500 mm Hg, the rate of ion formation can be assumed constant throughout the cylinder (shielding by the flux of thermal neutrons was insignificant). Satisfactory agreement between calculated and experimental data suggests that the adopted calculation model, diffusion coefficients, shock-radiative recombination, especially coefficients of conversion and dissociative recombination, and their dependence on electron and gas temperatures corresponding to the He^4 isotope fairly well describe processes occurring in He^3 isotopic gas plasma. The electron temperature was found to rise faster than the gas temperature: this was due to the increase in the rate of ionization and thus a growing fraction of electrons with higher energy. References 11: 7 Russian, 4 Western.

USSR

STUDY OF VELOCITY DISTRIBUTIONS OF EXCITED HYDROGEN ATOMS FORMED WHEN HYDROGEN MOLECULES ARE DISSOCIATED BY ELECTRON BOMBARDMENT

POLYAKOVA, G. N., YERKO, V. F., RANYUK, A. I., and PAVLICHENKO, O. S., Physicotechnical Institute, Academy of Sciences Ukrainian SSR

[Abstract] Velocity distributions of excited hydrogen atoms in states with principal quantum number n = 3, 4 and 5 formed when hydrogen molecules are dissociated upon electron bombardment at energies of 90, 130, 300 and 1000 eV were studied. The velocity distributions of the excited hydrogen atoms had two maxima: at velocities of $v \sim 0.6 \cdot 10^6$ cm/s and $v \sim 3.5 \cdot 10^6$ cm/s. These distributions show little change with electron energy. The group of "fast" hydrogen atoms is attributed to the process of dissociation when electron collision brings about transition of a hydrogen molecule from the ground state to auto-ionization repulsion states of the H_2^* molecule or molecular ion $(H_2^+)^*$. A possible cause of the group of "slow" excited hydrogen atoms with maximum at $v \sim 0.6 \cdot 10^6$ cm/s, may be the Franck-Condon transition to repulsion branches of bound electron states of H_2 molecules lying above the dissociation limit. Another process may be the transition of hydrogen molecules from their ground electron state to highly excited electron states, followed by predissociation to dissociable states of the H_2 molecule. The relative role of the predissociation process in formation of slow fragments might be decided by comparative experiments with deuterium. References 14: 2 Russian, 12 Western.

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LASER-DRIVEN THERMONUCLEAR FUSION

BRYUKNER, K.

[Text] The paper discusses problems of using powerful laser pulses to solve the problem of controlled thermonuclear fusion. Assuming the use of DT fuel, estimates are given of the required dimensions of the system, the characteristic time of the process and the required laser energy for a given amplification level in thermonuclear fusion. An examination is made of problems of interaction of radiation with matter, plasma implosion and selecting the laser emission wavelength. It is noted that the feasibility of developing a laser-driven thermonuclear power plant depends more on the economics of the target and the laser than on problems of technology in making the reactor.

CONTROLLED LASER-DRIVEN FUSION

BRYUKNER, K.

[Text] The author discusses a number of problems that must be solved to achieve controlled laser-driven fusion. It is pointed out that in numerical modeling of a thermonuclear device, the following physical phenomena must be taken into consideration: interaction of the laser with plasma; electronic and ionic heat conduction; electron-ion energy exchange; hydrodynamic movement with shock wave formation; nuclear reactions and energy transfer by radiation, α-particles, neutrons, and also charged particles that have undergone collisions with neutrons. The paper examines schemes of energy conversion and hydrodynamic motion in the target under the action of laser light, ignition and propagation of combustion, and also tailoring of the laser pulse. Relations are given for the energy required for implosion and ignition as a function of the degree of compression, and a diagram is presented for the motion of shock waves and implosion by three shock waves.

SELF-SIMILAR MODES OF COMPRESSION OF A PLASMA OF FINITE MASS

ZMITRENKO, N. V. and KURDYUMOV, S. P.

[Text] The problem of piston compression of a plasma of finite mass for one-
dimensional nonstationary equations of gasdynamics is amenable to a self-similar
formulation that is based on separation of lagrangian time and mass variables.
This paper demonstrates the feasibility of a solution with separation of
variables where dissipative processes are considered in a piston-compressed
plasma of finite mass with modeling of volumetric energy sources and drains
(due to volumetric emission) typical for a completely ionized plasma. An
examination is made of cases of adiabatic compression of a plasma of finite
mass by a piston, and compression of a completely ionized plasma by a piston
moving with fixed velocity. An analysis of the resultant self-similar solutions
revealed the conditions under which plasma compression with monotonically
increasing heat fluxes given on the piston leads to spatially nonequilibrium
variation of quantities in the compressed plasma.

LASER-DRIVEN THERMONUCLEAR FUSION VIS-À-VIS DECISIVE EXPERIMENTS

BOYER, K.

[Text] The paper discusses the outlook for the laser method of mastering con-
trolled thermonuclear fusion. A brief history of development of this method
is outlined. The following questions are examined in detail: physics of
thermonuclear combustion, absorption of laser emission, energy transfer, hydro-
dynamics of implosion, laser development. It is suggested that if success is
achieved, laser implosion should result in small thermonuclear reactors as
well as other devices similar to the jet engine.

FUSION WITH LASER-DRIVEN THERMONUCLEAR IGNITION IN SOLID DT TARGETS

BOBEN, ZH., KOLOMBA, D. and TONON, G.

[Text] An analysis is made of previously investigated approaches to the prob-
lem of using powerful lasers in controlled thermonuclear fusion, and a new
method is proposed that utilizes plasma dispersion occurring when a solid DT
target is exposed to a powerful laser beam with subsequent containment by a
strong magnetic field. An examination is made of a vaporization model that
satisfactorily describes the interaction of modern laser emission with a solid
target. It is noted that the neutron yield predicted by this model is observed
in experiments done with deuterated ice. The results are compared with other
models and schemes.

IMPLOSION OF DT TARGETS BY A LASER PULSE UNTIL CONDITIONS OF THERMONUCLEAR
FUSION ARE BROUGHT ABOUT

KLARK, DZH., FISHER, KH. and MEYSON, R.

[Text] The paper discusses the problem of implosion of spherical DT targets
by a tailored laser pulse to densities that ensure efficient thermonuclear
combustion. Phenomenological principles are given that govern the mutual
relations between the target mass, the threshold energy investment and yield
parameters $Y_R = E_{Out}/E_{Inv}$. It is shown that a yield parameter $Y_R = 4.7$ can be
achieved when a hollow spherical DT target massing 3 µg is exposed to a CO_2
laser pulse with energy of 1.9 kJ. Results are compared for hollow and solid
DT targets.

LASER-DRIVEN FUSION USING COMPLEX SPHERICAL SHELLS

AL'SHTROM, KH., SHTEYNKHAUER, L.

[Text] The paper discusses one of the possible methods of solving the problem of using lasers for controlled thermonuclear fusion based on the fact that moderate energy inputs are required for reaction in targets of small dimensions. The favorable circumstances for irradiating small targets consist in the simplicity of the equipment and the short time required for containment. An additional advantage of such a scheme is more energetic reaction as a consequence of the increase in target density. An examination of nonequilibrium implosion of DT targets showed that the minimum laser energy required for obtaining a positive yield is of the order of 100-1000 kJ.

INTERACTION OF HIGH-ENERGY PHOTON BEAMS WITH PLASMA

KIDDER, R.

[Text] The paper discusses problems of interaction of powerful laser emission with plasma from the standpoint of solution of the problem of controlled thermonuclear fusion. A brief overview is given on the properties of electromagnetic waves propagating in a completely ionized plasma, and examples are presented of the simplest hydrodynamic analysis of the influence that light pressure has on a plasma created by laser emission. Self-focusing of a light beam as a result of optical stresses in the plasma is considered. The authors discuss the scheme of distribution of the energy of a laser-driven thermonuclear reactor and the outlook of the laser method for solving the problem of controlled thermonuclear fusion.

PROBLEMS OF LASER-DRIVEN THERMONUCLEAR FUSION. COLLECTION OF PAPERS

Moscow PROBLEMY LAZERNOGO TERMOYADERNOGO SINTEZA. SBORNIK STATEY in Russian, Atomizdat, 1976, 295 pp

FILYUKOV, A. A. (translation editor)

[Text] The second collection of translated papers on laser-driven thermonuclear fusion and related problems, reflecting the state of the art as of 1972-1973. The first collection was put out by Atomizdat in 1973 (see RZh-Fizika, 1974, abstract No 2G403). The collection gives principal emphasis to papers dealing with the concept of ultra-strong adiabatic implosion of targets under the action of a powerful laser beam. The book contains 14 original papers examining the results of theoretical and experimental research on implosion of targets, and also evaluating the outlook for developing laser-driven thermonuclear power reactors.

COLLECTIVE PROCESSES WHEN NEUTRAL ATOMS ARE INJECTED INTO TOKAMAKS OF NON-CIRCULAR CROSS SECTION

Moscow KOLLEKTIVNYYE PROTSESSY PRI INZHEKTSII BYSTRYKH NEYTRAL'NYKH ATOMOV V TOKAMAK NEKRUGLOGO SECHENIYA in Russian, Institute of Atomic Energy imeni I. V. Kurchatov, IAE-2687, 1976, 16 pp, mimeo.

BARDAKOV, V. M., MIKHAYLOVSKIY, A. B.

[No text]

533.92:621.039.61

A NEW APPROACH TO THE USE OF LASERS FOR CONTROLLED THERMONUCLEAR FUSION

BELIKHOV, YE. P. and FILYUKOV, A. A.

[Text] Preface to a collection of translations of papers on the problem of laser-driven thermonuclear fusion. The papers are the first original publications on the physics of laser-driven fusion using ultra-strong implosion printed chiefly in the United States. It is pointed out that modeling of laser-driven fusion on high-speed computers has already indicated possibilities for ultra-strong implosion of matter, which is cause for optimism among physicists working in this field. The short-range outlook for development of laser fusion systems will apparently involve using such systems as sources of fast neutrons, and in combination with a uranium blanket -- as power installations with concomitant breeding of fissile materials.

HIGH-POWER GAS LASERS FOR THERMONUCLEAR RESEARCH

KOMPA, K. L.

[Text] The paper presents the principles of operation of gas lasers and their analysis from the standpoint of prospective use in laser-driven thermonuclear fusion. As an example the author considers iodine vapor lasers, comparing them with solid-state lasers, CO_2 lasers and lasers on new gases. A description is given of HF and xenon lasers that may serve as a good model for demonstration of the distinguishing features of lasers with stimulation of the electron spectrum of molecules, although they are not suitable for laser-driven fusion.

INITIATION OF THERMONUCLEAR REACTIONS BY HIGH-CURRENT ELECTRON BEAMS

VINTERBERG, F.

[Text] The paper discusses the problem of using high-current electron beams to make a thermonuclear reactor. A general description is given of the arrangement for initiating the reaction, and calculations of the electron beam parameters are presented. Problems of penetration of the magnetic field of the beam into the thermonuclear target and interaction of the beam with the plasma are discussed. Times are estimated over which the electron beam must be maintained to initiate thermonuclear combustion. The outlook for using gas targets is discussed. It is noted that a gas target scheme may be more economic since there would be no need for making solid targets; however, to all appearances thermonuclear ignition in a gas target will be difficult.

EXCITATION OF POTENTIAL SURFACE OSCILLATIONS OF A PLASMA BY A TUBULAR ELECTRON BEAM

IVANOV, S. T.

[Text] By using the conventional equation for the potential of small perturbations that depend on time and coordinates as $f(r)\exp(-i\omega t + il\phi + ik_z z)$ a dispersion equation is derived for longitudinal potential waves induced by a tubular non-relativistic electron beam with thin walls in a longitudinal magnetic field in a plasma with the same configuration and dimensions bounded by a vacuum. Only the case of rf oscillations is considered. Cases of development of beam and cyclotron instabilities are considered for long-wave and short-wave surface waves that can be induced only in an unmagnetized plasma (the long-wave oscillations -- in a rarefied plasma, and the short-wave oscillations -- in a dense plasma). The relation between increments of beam and cyclotron instabilities is discussed. The maximum amplitude of a steady-state monochromatic wave is estimated.

DAMPING OF COLLECTIVE OSCILLATIONS OF A BUNCHED PROTON BEAM

DIKANSKIY, N. S. and PESTRIKOV, D. V.

[Text] The authors examine the problem of stability of a grouped beam of protons interacting with an electron flux. It is shown that when the mean velocities of the beams coincide exactly, interaction leads to development of "fast damping" of coherent oscillations of protons. This effect can be used for damping of coherent oscillations of beams in accumulators with electron cooling.

AN ACHROMATIC ANALYZING SYSTEM WITH SEVERAL OUTPUTS

MILLER, V. V. and OBOZNYY, V. A.

[Text] A channel is proposed for transportation of a beam of π-mesons on the "Krasnaya Pakhra" meson factory. With the minimum number of identical magnets and quadrupole lenses the channel has satisfactory optical properties $(\Delta\Omega = 7$ msr, $(\Delta p/p)_{max} = 8\%$, $(\Delta p/p)_{min} = 0.2\%)$. Adjustment of achromatic beams is possible in four directions.

SOFTWARE FOR AUTOMATING AN ACCELERATOR IN THE 'ADVISOR-COMPUTER' MODE

ZAKHAROV, V. V., KOCHEGUROV, V. A., PRESLER, V. T. and ROGACHEVSKAYA, L. M.

[Text] The authors consider a version of an algorithm for optimizing the operation of a synchrotron with respect to maximum intensity with manual adjustment of the installation and use of a computer as an "advisor" in a mode without direct connection. The paper discusses problems of connecting the computer into the control cycle with an open feedback loop, but with automatic data collection. The procedure is described along with the software for BESM-4 computer simulation of the control mode, enabling effective debugging of software and training of operators.

A HIGH-VOLTAGE NANOSECOND PULSE GENERATOR WITH SYMMETRIC OUTPUT

GRISHANOV, B. I., LYSENKO, A. P. and KHARITONOV, YE. N.

[Text] The paper describes a simple high-voltage nanosecond square pulse generator with symmetric output and nanosecond synchronization. Output pulses with opposite polarity having an amplitude of up to 50 kV each are formed across a 50 Ω load by discharging a storage line precharged to +100 kV across two parallel cables with a helical cable inverter connected in a gap in one of them. The commutator is a three-electrode spark discharger in compressed gas triggered through a high-resistance helical line from a GMI-14B vacuum tube that can withstand a plate voltage of up to 36 kV and can handle a current pulse of up to 130 A. By using a high-voltage inverter at the output of the helical line in the trigger circuit, it was possible to create a simple heteropolar pulse generator on a single discharger triggered with nanosecond precision directly from the vacuum tube with commutation of voltage up to 100 kV.

INTERMEDIATE RING ACCELERATOR FOR THE INJECTION COMPLEX OF THE HIGH-ENERGY
LABORATORY. (BASIC PROBLEMS AND CHOICE OF STRUCTURE)

BALDIN, A. M., BELOV, V. P., VASILISHIN, B. V., DERYUGIN, G. M., ZINOV'YEV,
L. P., ISSINSKIY, I. B., KULAKOVA, YE. M., MAKAROV, L. G., MIKHAYLOV, V. A.,
MONOSZON, N. A., NADGORNYY, V. P., SEMENYUSHKIN, I. N. and SHUKEYLO, I. A.

[Text] A plan is proposed for a synchrophasotron that accelerates nuclei to
an energy of 0.5 GeV/nucleon. The installation can be used as an injector both
for the superconductive accelerator (nucleotron) that is under development, and
for the synchrophasotron at the Joint Institute of Nuclear Research. The mag-
netic structure with separated functions contains six periods, and the frequency
of betatron oscillations is 2.25. An acceptance of 20 $\pi \cdot$cm$\cdot$mrad in the hori-
zontal and vertical planes enables multiple-turn injection using coupling
resonance.

INFLUENCE THAT NONLINEARITIES OF THE MAGNETIC FIELD HAVE ON PARTICLE DYNAMICS
IN THE UPDATED PROTON SYNCHROTRON OF THE INSTITUTE OF THEORETICAL AND EXPERI-
MENTAL PHYSICS

ZENKEVICH, P. R., KOSHKAREV, D. G., TARASOV, YE. K. and VOROB'YEVA, YE. A.

[Text] Analytical and numerical calculations are done for a proton synchrotron
on the way that frequencies of betatron oscillations depend on the amplitudes
of free oscillations and pulse drift from the equilibrium value. These calcu-
lations showed that nonlinearities of the fields of magnet elements influence
the frequencies of radial oscillations of particles. The total spread of fre-
quencies of radial oscillations of particles in the beam at the beginning of
an acceleration cycle is 0.2. This spread gradually decreases to a few hun-
dredths in the process of particle acceleration due to attenuation of radial
and radial-phase oscillations.

CRITERION AND PROCEDURE FOR DETERMINING THE TYPE AND PARAMETERS OF ELECTRON
ACCELERATORS IN FLAW DETECTION

MOROZ, P. S. and POKROVSKIY, A. V.

[Text] Radiation flaw detection utilizes betatron, microtron and linac emission.
The specific field of application requires emission with certain parameters.
The method of mathematical modeling can be used to develop optimum emitters for
these purposes. A quantitative estimate of effectiveness is presented that
uses a complex criterion including both the expenditures for flaw detection
work and the target efficiency expected when this method of inspection is put
into practice. Computer calculations done over the entire range of variation
in beam parameters give the required beam parameters, focal length, etc. as a
function of inspection conditions. Algorithms and programs are developed for a
type M-20 computer that enable determination of minimum expenditures to achieve
optimum beam characteristics under specific inspection conditions. General
computational formulas are presented for estimating the economy of using emitters
in flaw detection.

CURRENT REVERSAL IN THE CORRECTING WINDINGS OF THE ISOCHRONOUS U-120M CYCLOTRON

DENISOV, YU. N., KALINICHENKO, V. V. and KRZHIVANEK, M.

[Text] The paper describes a thyristorized reversible DC commutator for the
power supply of the correcting winding in a cyclotron. Diagrams are given of
the principal components together with the results of an experimental study of
a pilot model of the commutator. The rated working current is 600 A. The
commutator can be controlled manually or by computer.

USSR   UDC   539.1.08

DESIGN OF A HIGH-CURRENT INJECTOR FOR A 300 MeV ELECTRON LINAC

BATYGIN, YU. V., GRISHAYEV, I. A., DOBNYA, A. N., KOLOT, Z. M. and MAKHNENKO, L. A.

[Text] The paper gives the calculation of a 300 MeV electron linac. It is shown that the proposed resonator beam shaping system has a waveguide section that gives electron bunches with phase extension of ~70°, current of ~40 A, and energy spread over the pulse duration of ~40% at the input to the main part of the accelerator.

USSR   UDC   539.1.08

INCREASING THE INTENSITY OF ACCELERATED BEAMS OF NUCLEI IN PROTON LINACS

BEZNOGIKH, YU. D., ZINOV'YEV, L. P., KARPOV, I. I., MONCHINSKIY, V. A. and POPOV, V. A.

[Text] The paper describes a method of increasing the intensity of accelerated beams of light nuclei in proton linacs. The method is realized in the LU-20 injector of the synchrophasotron at the Joint Institute of Nuclear Research. Experimental results are given.

A MICROWAVE POWER STABILIZATION SYSTEM

BLAZHEVICH, S. V., ZLUNITSIN, E. S., ZYKOV, A. I., KUSHNIR, V. A. and PLISKO,
V. N.

[Text] The paper describes an active regulating system for stabilizing rf
power of a klystron in the 10 cm band. The activating element is an elec-
trically tuned attenuator based on diodes with PIN structure. The system pro-
vides a stabilization coefficient of about 100 with a change in input power
over a range of ± 5 dB. The passband is ~30 MHz and a speed of action of about
10^{-3} s. An evaluation of this method shows the feasibility of maintaining
microwave power level within a precision to 10^{-5}.

A WAVEGUIDE CHANNEL PROTECTION CIRCUIT USING A MICROWAVE MODULATOR BASED ON
SWITCH DIODES

ALFEROV, V. N. and YAMPOL'SKIY, I. R.

[Text] The paper gives the design and characteristics of a microwave modulator
based on switching diodes, and also presents a scheme for using this modulator
to protect high-power channels from breakdown. The modulator is two 1A504A
diodes connected in parallel in a section of coaxial line with separation by a
quarter wavelength. The controlling voltage is fed to the diodes through sepa-
rative resistors. The modulator was tested in the frequency band of (2797 ± 10)
megahertz at a continuous power of (0.1-2) W. The VSWR of the modulator at
output is about 1.2, transmission losses ~0.8 dB, maximum attenuation at least
50 dB. Microwave power activation and deactivation time does not exceed 60 ns.

A DEVICE FOR WIDE-RANGE MEASUREMENT OF ELECTRON-BEAM CHARGE AND CURRENT

BEKHTEV, B. V., BORODULIN, A. I. and RYBIN, V. M.

[Text] The paper examines the operation of a magnetic induction current con-
verter with low-frequency correction circuit. When low currents and charges
are measured on charged-particle accelerators, the correction circuit appre-
ciably improves the sensitivity of the converter for given distortions in the
shape of the output voltage and measurement errors. This low-frequency correc-
tion circuit is an active integrator connected in a common feedback circuit,
and is based on an opamp that works in a recurrent input signal mode. Theo-
retical and experimental characteristics are given for a converter with correc-
tion circuit, and the authors describe the operation of a device for measuring
the current and charge of the beam from the U-31 electron linac at Moscow
Engineering Physics Institute. The device measures beam current pulse ampli-
tude in the range from $4 \cdot 10^{-5}$ to $4 \cdot 10^{-2}$ A, and charge per pulse in the range
from $6 \cdot 10^{-12}$ to $6 \cdot 10^{-9}$ C with an error of less than 5%, and also reproduces the
shape of beam current pulses lasting 0.2-0.3 μs with an error of ~10%.

SHAPING OF AN ELECTRON BEAM BY A SYSTEM OF RESONATORS

AFANAS'YEV, V. D., RUDYCHEV, V. G. and VISHNYAKOV, V. A.

[Text] The paper examines grouping of an electron beam by two and three reso-
nators working on a single frequency. Computer calculations show that for an
arbitrarily assigned interval of input phases and fixed ratios of the field
amplitudes in the resonators there are certain values of the grouping parameters
for which the shaped beam has a minimum phase extension of an electron bunch.
An investigation is made of the influence that the space charge has on the
process of shaping of electron bunches.

USING A KLYSTRON SELF-EXCITED OSCILLATOR ON A TWO-SECTION ACCELERATOR

BELOGLAZOV, V. I., VISHNYAKOV, V. A., GRISHAYEV, I. A., SDOBNOVA, L. N. and
FURSOV, G. L.

[Text] An examination is made of the results of using a high-power klystron
self-excited oscillator to feed an electron linac that boosts energy to 40 MeV.
The KIU-12 klystron operating in the self-excited oscillator mode furnishes
SHF power to the injector section and input circuit of a second klystron. The
requirements for the stability of the frequency generated by the SHF power
source are formulated on the basis of the theoretical and experimental charac-
teristics of the accelerator.

WIDE-BAND MAGNETIC INDUCTION SENSORS

KALININ, A. S.

[Text] A method is presented for eliminating the dependence of the signal of
magnetic induction sensors on beam displacement along the sensor winding.
Using this method enables one to measure the current and position of the beam
over a time much shorter than the time of signal propagation along the line
formed by the winding and shield. A description is given of a specific device
that consists of the beam current sensor and position sensors for two coordinates
that have a rise time of 4 ns and a decay time of the order of 1 ms.

CHARGE SENSORS FOR ISOLATED BUNCHES

KALININ, A. S.

[Text] Two types of sensors for the charge of isolated bunches of charged particles are considered: a current transformer loaded by capacitance, and an original sensor in which the main element is a coaxial line formed by the walls of a chamber. It is shown that these sensors can be used to measure the charge of nanosecond bunches.

A COMPACT ELECTRON LINAC WITH BEAM CIRCULATION

MUNTYAN, V. I., RUMYANTSEV, V. V., RYABTSOV, A. V., SMIRNOV, V. L. and SEVERGIN, YU. P.

[Text] The paper points out the feasibility of using repeated acceleration of electrons in the accelerating system of accelerators for applied purposes to increase the energy buildup per unit of length as well as the electronic efficiency. Theoretical parmeters are given for an accelerator with double passage of the beam through the accelerating section, and results are presented from a study of the accelerating system. The unit was designed and built at the All-Union Institute of Experimental Physics Equipment.

IMPACT ACCELERATION OF CHARGED PARTICLES

Moscow UDARNOYE USKORENIYE ZARYAZHENNYKH CHASTITS in Russian, Physics Institute of the Academy of Sciences USSR. High-Energy and Cosmic-Ray Physics. Photomeson Process Laboratory preprint No 53, 1976, 14 pp, mimeo.

BESSONOV, YE. G., KURAKIN, V. G. and SEROV, A. V.

[Text] An investigation is made of the salient features of impact acceleration of charged particles. Particulars are pointed out that distinguish this method from other acceleration techniques from the standpoint of formation of mono-energetic beams and beams of relativistic particles of short duration. A fairly detailed scheme is worked out for impact acceleration of charged particles by an electromagnetic field excited in the accelerating structures. The possibilities for realization of such a scheme are analyzed.

RESTRICTIONS ON THE SPECIFIC POWER OF AN ION SOURCE THAT ARE RELATED TO HEATING AND CATHODE SPUTTERING OF ELECTRODES

Moscow OGRANICHENIYA UDEL'NOY MOSHCHNOSTI IONNOGO ISTOCHNIKA, SVYAZANNYYE S NAGREVOM I KATODNYM RASPYLENIYEM ELEKTRODOV in Russian, Institute of Atomic Energy imeni I. V. Kurchatov, IAE-2628, 1976, 16 pp, mimeo.

GAMIL'TON, G. U. and SEMASHKO, N. N.

[Text] The authors calculate the possibilities and limitations of the water-cooled ion-optical system of an ion source necessary for continuous operation of a high-power neutral beam injector. The following problems are considered: thermal expansion and warping of electrodes, sputtering of electrodes under the action of bombardment, heat removal by the turbulent flow of water.

ON STABILITY DIAGRAMS FOR SOME FORMS OF SUPPLY VOLTAGES FOR THE SENSOR OF A
THREE-DIMENSIONAL QUADRUPOLE MASS SPECTROMETER

TERENT'YEV, V. I.

[Text] The paper gives the results of calculations of the coordinates of
vertices of common zones of stability for a three-dimensional quadrupole mass
spectrometer assuming certain shapes of the sensor supply voltage.

ON A METHOD OF CALCULATING BOUNDARIES OF ZONES OF STABILITY FOR THE MATHIEU
FUNCTION

SHERETOV, E. P., SAFONOV, M. P. and MZHEL'SKAYA, L. A.

[Text] The paper gives a form of the solution of the Mathieu equation that is
convenient for the theory of quadrupole mass spectrometers. On the basis of
this solution, relations are found that are suitable for calculating the
boundaries of the first zone of the stability diagram.

INVESTIGATION OF ASYMMETRY OF THE ANGULAR DISTRIBUTION OF PROTONS SCATTERED BY
TUNGSTEN SINGLE CRYSTALS

Moscow TRUDY SED'MOGO VSESOYUZNOGO SOVESHCHANIYA PO FIZIKE VZAIMODEYSTVIYA
ZARYAZHENNYKH CHASTITS S MONOKRISTALLAMI [Works of the Seventh All-Union Con-
ference on the Physics of Interaction of Charged Particles with Single Crystals]
in Russian, Moscow University, 1976 pp 155-158

GRIGOR'YEV, YU. A., YEREMIN, N. V., KAZAK, L. A. and PUZANOV, A. A.

[Text] The topology of regions of overlapping of axial and planar shadows is
studied in experiments on scattering of protons with energy of 620 keV. Regions
are found that have the highest sensitivity to displacement of a source of
particles from a crystal lattice site. It is suggested that investigation of
these regions in determining the lifetime τ of composite nuclei by the shadow
effect method could reduce the threshold of fixation of τ to $2 \cdot 10^{-19}$ s.

PRINCIPLES OF THE THEORY OF INJECTION OF IONS INTO THE SENSOR OF A THREE-
DIMENSIONAL QUADRUPOLE MASS SPECTROMETER

Ryazan' ELEKTRONIKA. MEZVUZOVSKIY SBORNIK STATEY. RYAZANSKIY RADIOTEKHNICHESKIY
INSTITUT [Inter-Institutional Collection of Papers. Ryazan' Radio Engineering
Institute] in Russian No 2, 1976 pp 37-41

SHERETOV, E. P., SAFONOV, M. P., KOLOTILIN, B. I.

[Text] A general theory is developed for the injection of ions from without
into the sensor of a three-dimensional quadrupole mass spectrometer. Principal
relations are presented that define the one-dimensional ion injection mode.
On the basis of the resultant relations, recommendations are made on choosing
the working conditions of the mass spectrometer. References 5.

CALCULATION OF YIELDS AND ANGULAR DISTRIBUTIONS OF BREMSSTRAHLUNG OF A THICK
TARGET

KITAYEV, V. YA., ABRAMOV, A. I., ROGOV, A. V. and YUTKIN, M. G.

[Text] A comparatively simple analytical formula is derived for numerical cal-
culation of the spectral distribution of bremsstrahlung at different angles
from a tungsten target with a thickness of 870 mg/cm^2 exposed to electrons with
energies of 10-15 MeV. The results are compared with experimental and theo-
retical data of other authors.

CONCERNING THE WAY THAT DIFFERENT PARAMETERS OF THE AXIAL SHADOW DEPEND ON THE
MAGNITUDE AND DIRECTION OF DISPLACEMENT OF A COMPOSITE NUCLEUS FROM A CRYSTAL
LATTICE SITE

MELIKOV, YU. V., OTSTAVNOV, YU. D., TULINOV, A. F. and CHECHENIN, N. G.

[Text] In most instances the measurement of lifetimes of excited nuclei by
the method of shadows presupposes machine modeling based on the Lindhard concept
of an isolated chain of atoms. Experiments done on fissioning of ^{235}U and ^{238}U
by neutrons with an energy of 1 MeV have shown that the depth of the shadow is
not very sensitive to lifetime, so that additional confirmation of the validity
of the chain model is required. This confirmation is obtained by studying
another shadow parameter -- the total number of particles thrown out beyond the
limits of the shadow angle as a result of interaction with the atomic chain.

INFLUENCE OF AXIAL AND PLANAR CHANNELING ON 1 GeV ELECTRON AND POSITRON BREMS-
STRAHLUNG SPECTRA IN SILICON AND GERMANIUM CRYSTALS

BOCHEK, G. L., GRISHAYEV, I. A., KOVALENKO, G. D. and SHRAMENKO, B. I.

[Text] The paper presents bremsstrahlung spectra measured for secondary elec-
trons (positrons) in the photon energy range of $0.2 < X < 0.8$, where X is the
photon energy in units of the initial electron (positron) energy. The Si and
Ge crystals had thicknesses of 640 and 165 μm respectively. Measurement errors
did not exceed 10%. The influence of channeling was determined by comparing
the experimental spectra with those calculated in the Born approximation; the
correctness of the calculations was checked by measuring the bremsstrahlung
spectra of electrons and positrons from an amorphous 0.5 mm aluminum target.
The authors discuss the experimental results and compare them with theory.

INVESTIGATION OF COHERENT BREMSSTRAHLUNG OF ELECTRONS ON THIN SINGLE CRYSTALS
OF DIAMOND

GANENKO, V. B., GORBENKO, V. G., ZHEBROVSKIY, YU. V., KOVALENKO, N. A., KOLESNI-
KOV, L. YA., KRIVETS, A. G., MIROSHNICHENKO, I. I., RUBASHKIN, A. L., SANIN,
V. M., SHALATSKIY, S. V. and SOROKIN, P. V.

[Text] An experimental study was done on coherent bremsstrahlung of electrons
with energy $E_0 = 1.3$ GeV from diamond single crystals 2, 0.3 and 0.08 mm thick.
Registration was from recoil protons detected after analysis by momenta using
scintillation counter telescopes. The telescopes had an energy resolution of
0.05 [sic]. Curves are given showing the way that the intensity of gamma
quanta depends on the angles of orientation of the diamond single crystals for
gamma quanta energy of 330 MeV.

CROSS SECTION OF THE DOUBLE CHARGE EXCHANGE $\pi^+ + {}^4He \rightarrow \pi^- + 4p$ AT PION ENERGIES
OF 98, 135, 145 AND 156 MeV

Dubna SECHENIYE DVOYNOY PEREZARYADKI $\pi^+ + {}^4He \rightarrow \pi^- + 4p$ PRI ENERGIYAKH PIONOV
98, 135, 145 I 156 MeV in Russian, Joint Institute of Nuclear Research
report P1-9591, 16 pp, mimeo.

LYASHENKO, V. I., PONTEKORVO, D. B., FALOMKIN, I. V., SHCHERBAKOV, YU. A.,
AL'BU, M., ANZHELESKU, T., BALEA, O., MIKHUL, A., NIKITIU, F., SERARU, A.,
BALESTRA, F., GARFAN'INI, R., PIRADZHINO, G., GUARAL'DO, K. and SKRIMAL'O, R.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V410]

[Text] The cross section of double charge exchange of positive pions on
helium nuclei is measured at different energies. The experimentally de-
termined energy dependence of the cross sections is compared with predictions
of different theoretical models.

NUCLEAR DIFFRACTION PROCESSES WITH THE PARTICIPATION OF LIGHT NUCLEI

Tashkent MNOZHESTVENNYYE PROTSESSY PRI VYSOKIKH ENERGIYAKH [Multiple Pro-
cesses at High Energies, Collection of Works] in Russian, "Fan," 1976
pp 55-77

ISMATOV, YE. I.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11V411]

[Text] The author considers the interaction of mesons, nucleons, deuterons
and other complex particles with nuclei. The amplitudes and cross sections
are calculated for different diffraction processes when nucleons and com-
plex particles interact with nuclei as a function of the smearing of the
boundaries of the nucleus, and also with consideration of the interaction
of nucleons within the target nucleus. A survey is given of the literature
for the past few years on the diffraction method of calculating nuclear
interactions.

YIELD OF FAST PROTONS AND THEIR ASYMMETRY IN NUCLEAR μ-CAPTURE

DOGOTAR', G. YE., SAKAYEV, R. A. and SALGANIK, YU. A.

[Text] The authors consider the yield of fast protons when muons are absorbed by the ^{16}O nucleus. The process was studied in the weak interaction momentum approximation using the traditional effective muon-nucleon hamiltonian.

RADIATION CAPTURE OF π-MESONS BY THE ^{6}Li NUCLEUS

SAKAYEV, R. A. and ERMAZHYAN, R. A.

[Text] The process of radiative capture of π-mesons by the ^{6}Li nucleus is examined within the framework of the shell model. Transitions to bound states and to states of giant resonance are considered. The gross structure of the spectrum of hard gamma quanta agrees well with measurement results.

INVESTIGATION OF GAMMA EMISSION FROM THE REACTION $^{12}C(p, \gamma p)^{12}C$

PARZHITSKIY, S. S., POPOV, YU. P., POYARKOV, V. A., SALEKH, Z. A., SIZOV, I. V. and STRIZHAK, V. I.

[Text] A germanium-lithium detector is used to measure gamma emission due to capture of protons with energy of 1.2 and 1.6 MeV to the ground state and the first excited state (2366 keV) of the ^{13}N nucleus. Information is obtained on the width and position of the 2366 keV level ($\Gamma = 34.6 \pm 1$ keV, $E_{res} = 2366 \pm 1$ keV). The particulars of the gamma spectrum from the reaction $^{12}C(p, \gamma p)^{12}C$ are discussed and compared with theoretical calculations.

USING THRESHOLD NUCLEAR REACTIONS WITH NEUTRON YIELD IN EXPERIMENTS WITH HIGH-CURRENT ELECTRON BEAMS

VOLOBUYEV, I. V., GRANATKIN, B. V., IVANOV, V. N., ISAKOV, A. I., KOLOMEN-SKIY, A. A., LIKHACHEV, V. I., SINIL'SHCHIKOVA, I. V. and SMIT, O. A.

[Text] The reaction $^{12}C(d, n)^{13}N$ with threshold of ~0.3 MeV was used to study the process of deuterium acceleration at low pressure by an intense electron beam. Experiments were done at an electron energy of 600 keV, current of 15-20 kA and pulse duration of ~50 ns. An investigation is made of the way that the neutron yield depends on deuterium pressure in the range of $0.08 \leqslant P \leqslant 0.2$ mm Hg. Maximum neutron yield corresponds to a pressure of 0.15 mm Hg. The energy of the accelerated deuterons was determined by three independent methods: from the time of flight, from absorption by foils, and by a magnetic spectrograph. It was found that the energy of the deuterons is strongly dependent on the operating stability of the accelerator, and amounts to from 1 to 4 MeV.

USSR   UDC   539.16+539.14

STATE OF THE ART IN MEASUREMENT OF FISSION CROSS SECTIONS OF THE PRINCIPAL
FISSILE ISOTOPES IN THE NEUTRON ENERGY RANGE OF $1-10^5$ eV. (A SURVEY)

BIRYUKOV, S. A. and GERASIMOV, V. F.

[Text] A survey of data on fission cross sections for ^{233}U, ^{235}U, ^{239}Pu and
^{241}Pu. The main emphasis is given to theoretical problems associated with
parametrization of these cross sections, measurement techniques and veri-
fication of the accuracy of estimated microscopic data in integrated ex-
periments.

USSR   UDC   539.16+539.14

CURRENT STATE AND OUTLOOK FOR RESEARCH ON NUCLEAR AND HYPERNUCLEAR PHYSICS
ON ACCELERATORS

SOKOL, G. A. and FETISOV, V. N.

[Text] A discussion of various aspects of the use of high-energy electrons
(200-1000 MeV) in nuclear physics. In studying the properties of the ground
states of nuclei and their first excitations, high resolution of the elec-
tron beam is a necessary condition for obtaining valuable information on
the structure of nuclei. When this condition is met, data on elastic and
inelastic scattering enable determination of the detailed behavior of form
factors in the case of large transferred momenta, and thus give important
information on the nature of nucleonic correlations at short distances.
A new area of nuclear physics is research on electro- and photoproduction of
mesons on nuclei, giving a great deal of information on the mesonic degrees
of freedom in nuclei. An examination is also made of the possibilities for
studying the properties of hypernuclei by using electrons and gamma quanta.

INVESTIGATION OF CONVERSION ELECTRONS WHEN ^{235}U IS FISSIONED BY THERMAL
NEUTRONS

POPEKO, L. A., RUDNEV, YU. P., PETROV, G. A. and KOCHUBEY, YE. F.

[Text]   An investigation is made of electron spectra in the energy region
of 150-1500 keV when ^{235}U is fissioned by thermal neutrons. The delayed
electron emission shows a line with energy of 843 ± 3 keV, period of 65 ± 10 ns
and intensity of $(2.5 \pm 0.5) \cdot 10^{-4}$ electron/fission. This line can be attribu-
ted to an isomeric $E0$ transition in one of the light fragments with charge
$Z = 40 \pm 1$. It is shown that the yield of electrons associated with the
fluctuation electromagnetic field of the fissile nucleus is $\leqslant 10^{-4}$ electron
per fission. It is confirmed that the predominant contribution to the prompt
gamma spectrum of the fragment nuclei is from $E2$ transitions.

MEASUREMENT OF THE RATIO α OF CAPTURE TO FISSION CROSS SECTIONS IN THE
NEUTRON ENERGY RANGE FROM 0.007 eV to 12 keV

RYABOV, YU. V.

[Text] The radiative capture to fision cross section ratio α is measured
for ^{239}Pu with expansion $\Delta t / L = 0.23$ μs/m. The experimental procedure con-
sisted in comparing the count of gamma quanta and prompt fission neutrons
from the specimen by means of a scintillation detector with pulse division
with respect to de-excitation time. Values of $\alpha(E)$ are given for ^{239}Pu in
the region of interacting neutron energies from 0.007 eV to 12 keV.

INVESTIGATION OF RESONANT ABSORPTION OF NEUTRONS IN A LATTICE OF THE RBM-K TYPE

YUROVA, L. N., BUSHUYEV, A. V., KOZHIN, A. F., YEGIAZAROV, M. B. and KAMANIN, P. M.

[Abstract] The paper gives experimental data characterizing the absorption of resonance neutrons in lattices of the RBM-K type at Leningrad Nuclear Electric Power Plant. Calculation of neutron absorption in these heterogeneous lattices involves difficulties due to the need for considering both the energy and spatial distribution of the moderated neutron flux. Strong intrachannel moderation causes appreciable spatial nonhomogeneity of the field of resonance neutrons in a cell. One way to solve the problem is experimental measurements on reactor core models. A change in concentration of hydrogen in the heterogeneous water film may influence physical processes in the intermediate-thermal neutron energy region. Therefore the integral parameters sensitive to this region of the neutron spectrum were measured -- ρ^{28}, $<\sigma_C^{28}>/<\sigma_f^{25}>$ and the effective resonant integral of absorption I_{eff}^{28}. The measurements were done on critical and sub-critical assemblies, with and without water in the fuel channels. Coefficients of self-locking are found for isolated fuel elements, and coefficients of mutual shielding are determined for elements in a cluster. It was found that filling the fuel channels with water has little effect on the effective resonant integral of absorption, but reduces the other two parameters (especially ρ^{28}) due to softening of the neutron spectrum. References 9: 6 Russian, 3 Western.

START-UP TESTS OF THE EFFECTIVENESS OF BIOLOGICAL SHIELDING OF A NUCLEAR ELECTRIC POWER PLANT WITH WATER-MODERATED WATER-COOLED POWER REACTOR

IZ"YUROV, A. S., KUZHIL', A. S., MIRONOV, V. N., RYMARENKO, A. I. and TSYPIN, S. G.

[Russian abstract provided by the source]

[Text] Experiments gave detailed information on the main source of ionizing radiation -- the reactor itself. In addition, a more detailed investigation was done on the gamma radiation of equipment in the in-pile loop. Specific radioactivity of the coolant in the in-pile loop of the VVER-440 reactor was determined. The experimental data can be used to improve the design of

biological shielding and to develop computational techniques. A safety caisson for inspecting a reactor vessel is described. Use of such a caisson for a single inspection has saved 600,000 rubles. References 6 Russian.

COHERENT INSTABILITY OF THE BEAM ON THE ACCELERATOR AT THE INSTITUTE OF HIGH-ENERGY PHYSICS

BALBEKOV, V. I. and GERTSEV, K. F.

[English abstract provided by the source]

[Text] The results of experimental investigation of coherent instability of vertical and radial betatron oscillations in the IHEP accelerator are reported. It is shown that the instability is due to the interaction of the beam with the walls of the vacuum chamber. Positive ions formed during ionization of residual gas by the beam produce a small stabilizing effect. Experimental data and calculations are in agreement within about 30%. References 5: 2 Russian, 3 Western.

THE 'DOLPHIN' HIGH-POWER 12-CHANNEL LASER UNIT FOR SPHERICAL HEATING OF THERMO-NUCLEAR TARGETS

BASOV, N. G., DANILOV, A. YE., KROKHIN, O. N., KRUGLOV, B. V., MIKHAYLOV, YU. A., SKLIZKOV, G. V., FEDOTOV, S. I. and FEDOROV, A. N.

[Text] The paper describes the powerful "Dolphin" 12-channel laser unit designed for high-temperature heating of thermonuclear targets in spherical irradiation geometry. The installation includes a neodymium laser with maximum emission

energy of ~10 kJ, light pulse duration of ~10^{-10}–10^{-9} s and emission divergence of $5 \cdot 10^{-4}$ rad, a vacuum chamber in which the laser emission is interacted with the plasma, and a complex of facilities for diagnosing laser and plasma parameters. The optical arrangement and design particulars of the laser system are considered. An analysis is made of schemes for focusing emission onto the target, and the focusing system of the "Dolphin" installation is described. This system gives a high degree of symmetry of target irradiation with a maximum density of the flux at the target surface of ~10^{15} W/cm^2. The authors examine the main problems of physical research on a laser plasma and the principal diagnostic facilities for solving them.

PROBLEMS OF TRITIUM PRODUCTION, RADIATION DAMAGE AND NEUTRON ACTIVATION OF MATERIALS IN THE BLANKET OF PULSED THERMONUCLEAR REACTORS

DÄNNER, W.

[Text] An examination is made of three blanket designs for pulsed thermonuclear reactors that are intended for a reactor of the theta-pinch type (RTPR) and for the LFPP and "Saturn" laser-driven reactors. The designs are considered from the viewpoint of tritium production, and activation and radiation damage of structural materials. Different methods of regenerating tritium from the reactor blanket material are discussed. Consideration is given to the need for ensuring a low level of tritium accumulation in the blanket to achieve a fairly short doubling time. It is noted that existing data on radiation damage of possible structural materials for thermonuclear reactors are not adequate for drawing reliable conclusions on the suitability of a given material. An examination is made of the particulars of radiation damage to insulators that lead to a reduction in their electrical resistance and permittivity. Considerations are presented in support of the view that some types of radiation damage will be annealed in the time between neutron pulses. It is asserted that neutron activation of structural materials in thermonuclear reactors is not as serious a problem as the formation of fission products in nuclear reactors since the probability of massive accidents is considerably lower in this case. Estimates are made of the biological hazard of installations with thermonuclear reactors, as well as the magnitude of residual heat release in activated structural elements.

PLAN OF THE 'SATURN' LASER-DRIVEN THERMONUCLEAR INSTALLATION

FOERSTER, S., BOHN, F. H., CONRADS, H., DARVAS, J. and SACH, B.

[Text] The paper gives the plan of the chamber of the "Saturn" thermonuclear
reactor designed for 5000 MW of thermal power. The construction and type of
laser system are not discussed. The proposed interaction chamber, including
blanket, devices for conversion of the energy released, mechanism for insertion
of LiD and LiT targets and vacuum chamber is based on criteria of reliability,
servicing safety, the possibility for using existing hardware, and also con-
siderations of economic nature. The proposed number of laser beams is 60,
frequency of reactor ignition 100 Hz, laser beam energy per pulse 0.6 MJ.
The most specific features of the proposed version of the reactor are complete
mechanical separation of the system of fuel injection and ignition and the
system of energy regeneration and conversion, use of several energy conversion
modules and several vacuum modules connected directly to the blanket, provision
for removing and repairing blanket modules under load, and finally, an original
system for using helium to inject the fuel pellets. A detailed analysis is
made of the energy distribution in the reactor, wall effects caused by thermo-
nuclear reaction products, problems relating to protection of optical elements
that focus the laser beams onto the target. The energy balance of the entire
installation gives a pure efficiency of about 30%.

A TOROIDAL REACTOR OF THE THETA-PINCH TYPE

RIBE, F. L.

[Text] The paper discusses the principles of operation, parameters and design
of a thermonuclear reactor of the theta-pinch type (RTPR) developed jointly by
the Los Alomos and Argonne laboratories (United States). The total thermal
power of the RTPR reactor is 3600 MW at electric power production efficiency of
49% using a potassium heat-removal cycle. The reactor is made up of 100

separate modules 2 m in length with 50 cm radius of the plasma chamber. The compressive magnetic field is 11 T, and the magnetic field for impact heating of the plasma is 1.38 T. The ratio of the plasma pressure to the magnetic field pressure $\beta \sim 1$. The energy balance in the system and the dynamics of the DT-reaction are considered. The characteristics of the blanket are estimated when different systems of heat removal and levels of thermal and radiation loads on the first wall are used.

KHENKOKS, R. and SPOLDING, I.

[Text] The paper examines the technical and economic characteristics of laser-driven thermonuclear reactors with superdense plasma. It is noted that from the economic standpoint efforts should be made to reduce energy expenditures on internal needs, using lasers with high efficiency and ensuring a high degree of burn-up in the imploded core. An estimate is made of the typical cost of a DT system that can compete with a nuclear fast-neutron breeder reactor. The authors discuss factors that could affect thermonuclear yield and that have not been considered in numerical experiments. It is pointed out that inertial thermonuclear reactors have the following potential advantages over reactors with magnetic containment: a) simplicity of operation; b) simplicity of design and low capital investment; c) elimination of the need to maintain a high vacuum; d) automatic handling of facilities for ignition, fuel feed and removal of fusion products; e) simplicity of monitoring the average output power of the reactor. The following problems are noted as specific to laser-driven syn-thesis: a) development of a high-efficiency laser with tailored pulse; b) development of pumping systems with high recurrence rate and long service life; c) development of combustion chambers with high recurrence rate that can with-stand heavy energy loads.

USSR

A LAYER OF NEUTRAL GAS FOR HEAT REMOVAL

BRANDT, B.

[Text] The paper examines different aspects of the use of a gas blanket placed between the plasma and the first wall of a thermonuclear reactor. Such a blanket serves to prevent the chamber wall from vaporizing under the action of charged particles, transfers heat into the reaction zone and promotes cleaning of the reaction zone as a consequence of gas diffusion. The gas blanket can also be used to remove impurities from the plasma before they reach the hot core. In pulsed reactors a gas blanket could be used to control temperature and density profiles in the vacuum chamber, and to regulate the development of these profiles with time. The author discusses the feasibility of forming a gas blanket in a pulsed reactor at the instant of cessation of the thermonuclear reaction to increase heat transfer from the plasma to the wall of the chamber or to absorb plasma energy. Calculated parameters of the plasma and gas blanket of a pulsed reactor are presented. It is shown that the gas blanket solves the problem of heat removal from the plasma and protection of the chamber wall; however, there are certain difficulties in the formation of such a blanket and in pumping out the gas at the end of a cycle. It is noted that the possibilties and advantages of the gas blanket are of particular moment for pulsed reactors.

EAST GERMANY

CALCULATION AND EXPERIMENTAL VERIFICATION OF NEUTRON FLUENCES WITHIN BODY
PHANTOMS UNDER IRRADIATION IN VARIOUS NEUTRON FIELDS

DOERSCHEL, B., and PROKERT, K., Dresden Technical University, Physics Section,
No. 3 Experimental Physics Group

[Abstract] The fluence distributions in a body phantom were calculated by means
of the SPECT4 Monte Carlo program. The phantom was a water-filled elliptical
cylinder with half axes of 18 and 12 cm, and a height of 60 cm. The calcula-
tions were carried out for primary reactor, cyclotron, and 14 MeV neutrons,
with the assumption of a 10 cm diameter beam of primary neutrons. The total
fluence was measured on the basis of the readout of a single detector, using
information about the percentage of thermal, intermediate, and fast neutrons.
The results are presented in graphic form. The calculated fluence distribu-
tions of the various neutrons exhibited the typical form of water moderation.
There was exponential decrease of fluence of fast neutrons with increasing
penetration depth, and there were maximums for the fluence of thermal and in-
termediate neutrons. The fluence profile perpendicular to the irradiation di-
rection corresponded to a fanning of the primary neutron beam. There was good
agreement between calculated and measured values. Figures 12; references 5:
1 Western and 4 German.

EAST GERMANY

ABSOLUTE DIFFERENTIAL NEUTRON-EMISSION CROSS SECTIONS FOR Ga, Se, Br, Zr, Nb,
Cd, In, Sn, Sb, I, Ta, W, Au, Hg, Pb, AND Bi AT 14 MeV INCIDENCE ENERGY

HERMSDORF, D., MEISTER, A., SASSONOFF, S., SEELIGER, D., and SEIDEL, K.,
Physics Section, Dresden Technical University

[Abstract] This article, the last of a series of four, presents absolute dif-
ferential neutron-emission cross sections for the elements listed in the title
as determined by time-of-flight spectrometry for five scatter angles between

40 and 150° in the emission-energy range between 2 and 14 MeV. The information is presented in diagrams. The results presented were compared to corresponding data published in the literature. Only in the case of Zr and Bi were there differences beyond what may be judged experimental deviations. There is good agreement between the neutron-emission cross sections determined on the basis of the integral non-elastic cross section and measured directly by emission spectrometry, except for Se and Zr (in which the deviations exceeded 10 percent). Tables 3; figures 33; references 28: 8 German, 3 Russian, and 17 Western.

EAST GERMANY

STUDIES ON THE OPTIMIZATION OF THE COIL CONFIGURATION IN INDUCTION ACCELERATORS FOR ELECTRONS IN IRON-FREE DESIGN

UNVERRICHT, A., Friedrich Schiller University, Radiological Clinic, Betatron Department, Jena

[Abstract] Studies were carried out to establish the relationship between the coil configuration (cross section, number of windings, air gap size) in induction accelerators for electrons and the attainable electron intensity, and to find out whether the calculated results of these studies can be confirmed by experiments on actual magnet systems. By using the stabilizing potential it is possible to determine and optimize the size of the stabilizing range as a function of coil configuration. A toroidal cross section should be well adapted to the configuration of the stable range and the shape of the core, and the latter should match well the course of the equipotential surfaces. There was good agreement between calculated and experimentally determined values. Low-iron or no-iron designs reduce the size of the betatron, make it lighter in weight, reduce its cost, and permit the coil configuration to be optimized. The results contribute to the development of high-performance small betatrons with energies of up to 5 MeV. Figures 10; references 17: 11 German, 3 Russian, and 3 Western.

EAST GERMANY

STUDIES ON THE ACCURACY OF THE CALCULATION OF THE GAMMA SPECTRUM OF FISSION
PRODUCTS

PULZ, E., and KRUEGER, F. W., Power Plant Construction Combine State Enterprise,
Berlin-Pankow, and State Bureau of Nuclear Safety and Radiation Protection in
the German Democratic Republic, East Berlin

[Abstract] Gamma spectra of momentarily generated mixtures of fission products
were calculated as a function of decay time. The calculations were carried out
with the aid of the AKTIVIST III program, and the fission process was the fis-
sion of ^{235}U by thermal neutrons. The computed results were compared with ex-
perimentally obtained data as published in the literature. Comparisons were
also made between the data calculated with the AKTIVIST III program and other
published methods. The differences in data obtained by different methods of
calculation were relatively small; their interpretation was discussed. But
certain simplifications in the procedures of calculation or measurement may
increase the differential. Figures 6; tables 3; references 16: 6 German and
10 Western.

INVESTIGATION OF AN ARC PLASMA OF INERT GASES AT HIGH PRESSURE

NESTEROV, YE. V.

[Text] A plasma of inert gas (helium, neon) is created in an electric arc of
miniature dimensions at pressures of 30-500 atmospheres with optical thickness
$\tau \leqslant 1$. Optical methods were used to measure temperature, line broadening and
emission intensity in the continuous spectrum in the wavelength range of
5000-7000 Å. Broadening of spectral lines is several times greater than the
theoretical value at pressures above 100 atmospheres. The coefficient of
emission is also considerably higher than the calculated value. The optical
reduction in the ionization potential is compared with results of other authors.

OPTIMIZING THE PARAMETERS OF AN OPTO-ELECTRONIC SYSTEM IN THE SEARCH MODE

MISHCHENKO, N. I., PUSTYNSKIY, I. N., and SUVOROV, B. I.

[Abstract] The tracking accuracy of an opto-electronic system for location
of point objects can be improved with a concomitant reduction in the search
time by preliminary (coarse) determination of the coordinates of the object
in conjunction with the narrow-angle (fine) system of search and tracking.
In this case the probability density of the coordinates in the search field
of the system is close to gaussian with near-zero mathematical expectation,
whereas the probability density is usually taken as uniform, and the proba-
bility of the object being found in the search field is assumed known, and
most often equal to unity. The authors determine the optimum dimensions of
the search field, scanning rate and other parameters of an opto-electronic
system that maximize sensitivity for a given probability of detection of a
point object, which depends on the probability that the object will be in
the search field, the probability that it will be moving at a given speed,
and the probability of signal detection. It is shown that the probability of
a false alarm has practically no effect on the optimum values of the size of
the search field and scanning parameters.

USSR

A CRITERION FOR THE BREAKDOWN OF DIELECTRICS INDUCED BY STRONG OPTICAL
RADIATION PULSES

ZAKHAROV, S. I., All-Union Scientific Research Institute of Physical-Optical
Measurements

[Russian abstract provided by the source]

[Text] A phenomenological criterion for the breakdown of dielectrics in-
duced by light monopulses is proposed. The distribution of the increase in
the density of internal energy in the optical radiation absorption region
with respect to electron and phonon subsystems is investigated; limits of
the applicability of the von Hippel criterion to the optical breakdown
problem are examined. The validity of the Seitz criterion is examined
from the standpoint of the criterion proposed by the author. The tempera-
ture criterion for breakdown of dielectrics in this category is also
discussed. Expressions are derived for the coefficient of absorption of
strong optical radiation in dielectrics. References 17: 13 Russian,
4 Western.

USSR

STIMULATED RAMAN SCATTERING AND SELF-FOCUSING OF LIGHT IN SUBSTANCES WITH
DIFFERENT EFFECTIVE CROSS SECTION OF RAMAN SCATTERING OF LIGHT

GAZENGEL, J., and RIVOIRE, G., Technological Institute, Angers, France,
KUDRYAVTSEVA, A. D., and SOKOLOVSKAYA, A. I., Physics Institute imeni
P. N. Lebedev, Academy of Sciences USSR

[Abstract] Self-focusing of the first Stokes component of stimulated Raman
scattering and laser light was investigated for a large number of substances
that have different optical characteristics. The substances were chosen
so that the Kerr constant and the effective cross section of Raman scattering
were sensibly different. Raman scattering was stimulated by giant pulses
of a single-mode ruby laser. Variables characterizing the buildup of
stimulated Raman scattering and self-focusing of light in these substances
were compared (Kerr constant, gain factors of transformation of laser light
into stimulated Raman scattering power density at the points of

minimum-diameter self-focusing and others). These substances were investigated: CS_2, $C_6H_5NO_2$, C_6H_6, $CHCl_3$, N_2, $CaCO_3$, C_6H_{12}, CCl_4 and CH_3COCH_3. Factors leading to common properties and differences in the buildup of self-focusing in substances with widely varying Kerr constants are discussed. References 29: 16 Russian, 13 Western.

USSR

MAGNETIC FORCES ON THE SURFACE OF A SUPERCONDUCTOR

SHIKINA, N. I., Institute of Solid State Physics, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The theory of ponderomotive phenomena at the surface of a super-conductor of arbitrary size is derived, valid within the limits of applica-bility of the London equations or the Ginzburg-Landau equations. The formalism that results serves to describe several effects observed: the influence of magnetic forces on the law of dispersion of flexural oscil-lations of a plate of arbitrary thickness in a parallel magnetic field, the appearance of an electric quadrupole moment on a superconducting sphere in a uniform magnetic field and so on. The existence of a potential difference between the equator and the poles of this sphere in a magnetic field is confirmed experimentally. A consistent theory of perturbations is proposed for solving the Ginzburg-Landau equation under given conditions with respect to calculating magnetic forces on the surface of a thin plate of a type I superconductor.

USSR   UDC 537.52

ON THE FEASIBILITY OF DETERMINING THE PROPERTIES OF A MEDIUM FROM THE RESPONSE
OF A DIFFUSE DISCHARGE TO AN INERTIAL EFFECT

Moscow TEPLOFIZICHESKIYE SVOYSTVA NIZKOTEMPERATURNOY PLAZMY [Thermophysical
Properties of Low-Temperature Plasma, Collection of Works] in Russian, "Nauka,"
1976 pp 65-69

SHMIGEL', A. I.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G269 by the author]

[Text] An examination is made of diffuse discharge under conditions of trans-
verse convection caused by the action of forces of inertia or gravitation on
the discharge. The author studies the behavior of the discharge as a function
of the thermophysical properties of the gas-discharge medium for both steady
and periodic action. The theoretical results concerning the influence that
these properties have on displacement as well as on the amplitude and phase
characteristics of the discharge are confirmed by experimental data.

USSR   UDC 539.9.01

DETERMINATION OF THE ELECTRON CONCENTRATION IN A TWO-TEMPERATURE SYSTEM MADE UP
OF A GAS AND HIGHLY DISPERSED NEGATIVELY THERMIONIC PARTICLES

Moscow TERMOFIZICHESKIYE SVOYSTVA NIZKOTEMPERATURNOY PLAZMY [Thermophysical
Properties of Low-Temperature Plasma, Collection of Works] in Russian, "Nauka,"
1976 pp 10-14

SAMUYLOV, YE. V. and GORBATOV, A. V.

[From REFERATIVNYY ZHURNAL, FIZIKA No 11, 1976 Abstract No 11G6 by the authors]

[Text] The distribution of electron concentration and temperature is found
in a two-temperature system where the temperature of the particles exceeds the
temperature of the ambient gas. The problem is solved in the quasi-steady state
approximation. Due to the difficulties that arise in solving the self-consistent
equation in the thermodynamic-equlibrium case, the authors examine two limiting
potential distributions for which electron temperature and concentration pro-
files are found in the vicinity of a spherical thermionic particle.

CALCULATING THE COMPOSITION OF DENSE MULTICOMPONENT PLASMAS

ABLEKOV, V. K., KASHNIKOV, G. N., KOZLOV, N. P., LESKOV, L. V., MALASHCHENKO,
V. A., PROTASOV, YU. S. and SAVICHEV, V. V.

[Text] The composition of various plasmas is calculated over a range of
5000-90 000 K in temperature and 10^{16}-10^{19} cm^{-3} in electron concentration,
assuming local thermodynamic equilibrium. The existence of local thermodynamic
equilibrium in the plasma focus of a magnetoplasma compressor of erosion type
has been proved by comparing the results of investigations of plasma parameters
(n_e, n_i, T_e, T_i) using independent methods, and by checking compliance with
criteria of existence of local thermodynamic equilibrium in the plasma. The
missing values of statistical sums for the first to fifth ions of the plasma
forming elements were calculated by an approximate method. The paper presents
the technique and results of digital computer calculation of the composition of
fluorine-carbon and structurally similar multicomponent dielectric plasmas, and
also plasmas of a number of metals that are working fluids in magnetoplasma
compressors of erosion type.

SOME PROBLEMS OF THERMODYNAMIC CALCULATION OF A MULTICOMPONENT NON-IDEAL PLASMA

GRYAZNOV, V. K. and IOSILEVSKIY, I. L.

[Text] The paper describes a program for thermodynamic calculation of a multi-
component plasma. A number of the particulars of such a calculation are dis-
cussed. Truncation of statistical sums leads to additional dependence on
thermodynamic parameters. This dependence shows up in the region of appreciable
non-ideality, and is closely related to the latter. For successful description
of strong non-ideality it is essential to comply with general relations that are
not related to the smallness of the parameter of interaction. Use of these
relations to correct a number of known approximations noticeably improves their
extrapolation properties.

UDC 539.9.01

SHOCK-WAVE COMPRESSION OF A NON-IDEAL PLASMA

FORTOV, V. YE., DREMIN, A. N., LEONT'YEV, A. A., LOMAKIN, B. N. and GRYAZNOV,
V. K.

[Text] The paper examines a dynamic method of creating and studying a non-ideal
plasma that is based on compression and heating of gases on a strong shock wave
front. An explosive shock wave generator is described. The caloric equation
of state of a non-ideal argon and xenon plasma was determined by using conser-
vation laws through registration of the kinematic parameters of shock wave
propagation.

UDC 539.9.01

INVESTIGATION OF THE PROPERTIES OF A FLAME PLASMA BASED ON EXPERIMENTAL DATA ON THE ELECTRON ENERGY DISTRIBUTION FUNCTION

ZAYTSEV, A. S., KITOVA, S. V., TVERDOKHLEBOV, V. I., TVERDOKHLEBOVA, L. S.

[Text] Studies were done on the flame plasma of an oxyacetylene torch at a
pressure of 2 mm Hg. In all zones of the flame measured with respect to the
second derivative of the probe current the energy spectrum of electrons differs
from maxwellian. In the experimentally found spectrum there is a deficit of
both high-energy electrons and those with very low energy. An estimate is made
of the rate of ionization of the mixture.

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